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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

**NORTH-CENTRAL OCEAN BASIN
REGIONAL WASTEWATER TREATMENT FACILITY
WORCESTER COUNTY, MARYLAND**

COMPLETED

ORIGINAL



Map of the
North-Central Ocean Basin
Regional Wastewater Treatment Facility
Worcester County, Maryland



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION III

**6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106**

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**NORTH-CENTRAL OCEAN BASIN
REGIONAL WASTEWATER TREATMENT FACILITY
WORCESTER COUNTY, MARYLAND**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

August 15, 1977

TO ALL INTERESTED AGENCIES, PUBLIC GROUPS, AND CITIZENS:

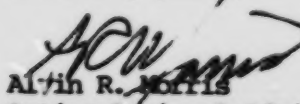
Enclosed is a copy of the Draft Environmental Impact Statement (EIS) for the proposed construction of the North-Central Ocean Basin Wastewater Treatment Facility, Worcester County, Maryland.

Pursuant to the National Environmental Policy Act of 1969 and regulations promulgated by this Agency (40 CFR 6, April 14, 1975) comments or inquiries concerning this Draft EIS should be submitted to the above address for the attention of the Environmental Impact Branch - EIS Preparation Section by October ¹³~~8~~, 1977.

A public hearing to solicit testimony concerning the Draft EIS will be held on September 27, 1977 at 3:00 p.m. in the Stephen Decatur High School Auditorium, Berlin, Maryland. Individuals and representatives of organizations wishing to testify at the Public Hearing are requested furnish a copy of their proposed testimony (if possible) along with their name, address, telephone number and the organization they represent to the EIS Preparation Section at the above address not later than the close of business on September ²¹~~8~~, 1977. Witnesses should limit their oral presentation to a five-minute summary of their written testimony. If time permits, others present at the hearing who wish to testify may do so after the witness list has been called.

I welcome your interest and participation in the EIS process.

Sincerely yours,


Alvin R. Morris
Acting Regional Administrator

Enclosure

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

NORTH-CENTRAL OCEAN BASIN
WASTEWATER TREATMENT FACILITY
WORCESTER COUNTY, MARYLAND

Prepared for

U. S. Environmental Protection Agency
Region III
Philadelphia, Pennsylvania

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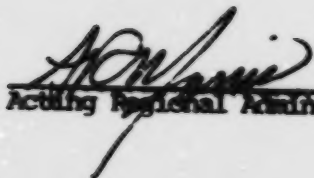

Acting Regional Administrator

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ABBREVIATIONS

ADT	- Average Daily Traffic
AQCR	- Air Quality Control Region
BAQNC	- Bureau Air Quality and Noise Control (Maryland)
BOD	- Biological Oxygen Demand
CEQ	- Council on Environmental Quality
cfs	- Cubic feet per second
CIP	- Capital Improvement Program
CO	- Carbon Monoxide
CBI	- Chesapeake Bay Institute
COE	- Corps of Engineers (U. S. Army)
dBA	- Decibels (A Scale)
DHMH	- Department of Health and Mental Hygiene (Maryland)
DNR	- Department of Natural Resources (Maryland)
DSPO	- Delaware State Planning Office
Du	- Dwelling Unit
EHA	- Environmental Health Administration (Maryland DNR)
EIS	- Environmental Impact Statement
EPA	- Environmental Protection Agency (U.S.)
ERDA	- Energy Research and Development Agency (U.S.)
GMB	- George, Miles & Buhr
gpd	- gallons per day
gpcd	- gallons per capita per day
gpm	- gallons per minute
H ₂ O ₂	- Hydrogen peroxide
I/I	- Infiltration/Inflow
MDSP	- Maryland Department of State Planning
MES	- Maryland Environmental Service
mgd	- million gallons per day
mg/l	- milligrams per liter
MHT	- Maryland Historic Trust
MPN	- Most probable number
NEPA	- National Environmental Policy Act
NMFS	- National Marine Fishers Service
NPDES	- National Pollutant Discharge Elimination System

O&M	- Operation and Maintenance
°/oo	- parts per thousand
P.L. 92-500	- Federal Water Pollution Control Act Amendments of 1972
SCS	- Soil Conservation Service (U.S.)
SHA	- State Highway Administration (Maryland)
SO ₂	- sulfur dioxide
STP	- Sewage Treatment Plant
TKN	- Total Kjeldahl Nitrogen
TSP	- Total Suspended Particulates
WCPC	- Worcester County Planning Commission
WCSC	- Worcester County Sanitation Commission
WRA	- Water Resources Administration (Maryland)

SUMMARY

- (X) Draft Environmental Impact Statement
() Final Environmental Impact Statement

U.S. Environmental Protection Agency
Region III
Philadelphia, Pennsylvania

1. Name of Action

Administrative (X)

Legislative ()

2. The Worcester County Sanitary Commission (the applicant) has requested Federal financial assistance, under statutory authority of the Federal Water Pollution Control Act Amendments of 1972, for the expansion and upgrading of the 9 million gallon per day (mgd), primary, sewage treatment facility at Ocean City, Maryland to a secondary facility with a treatment capacity of 20.5 mgd, and construction of an 8.9 mgd secondary, sewage treatment facility near West Ocean City. The Ocean City facility would receive wastewater only from Ocean City. The service area of the West Ocean City facility would include West Ocean City, Berlin, the community of Ocean Pines and extensive areas along the major highways in the proposed service area. The applicant's proposal is the selected alternative of the Facilities Plan for the North Central Ocean Basin prepared by George, Miles, and Buhr (1977) of Salisbury, Maryland.

The applicant's design engineer has estimated that the proposed project will incur the following major capital costs:

Expansion of the Ocean City treatment plant (9 to 20.5 mgd)	\$ 24,915,000
Construction of the West Ocean City treatment plant (8.9 mgd)	23,015,000
Construction of the Mainland Collection System	10,805,000

3. The proposed collection and treatment facilities were designed to alleviate public health hazards, to improve water quality, and to continue resort-oriented growth to the area of the North Central Ocean Basin designated for that use by the Worcester County Comprehensive Plan. The proposed facilities were also designed to provide secondary treatment to the wastewater generated by the service area population projected for the year 2000. Construction of both treatment facilities will be phased, but the collection system would be installed during the first phase of the program.

EPA's review of population, wastewater flow, water supply, and economic projections for the proposed service area indicates that the applicant's proposed facilities may provide excessive treatment capacity and the proposed interceptors do not provide a means for controlling the location of development within the proposed service area. In addition, wastewater flow projections for Ocean City are significantly greater than projected water supplies. All of the projections of growth in the proposed service area were completed before recent concern about fuel conservation, increasing gasoline prices, and significant traffic congestion on the major highways on Maryland's Eastern Shore. EPA recognizes that the effects of these occurrences upon growth in the service area are not resolved in this EIS, but proposes that these effects be evaluated during the phasing of the wastewater management program.

The outfall from the proposed West Ocean City facility would cross the Assateague Island National Seashore Park. The National Park Service has expressed reservations about the proposed outfall but has not completely rejected the outfall route. EPA has determined that the proposed outfall is cost effective and will have short-term, minimal impact upon environment of the island.

Minor short-term, adverse impacts will occur during construction of the proposed facilities. Construction will result in increased noise levels, dust and air pollutant generation, erosion and sedimentation, and disruption of wetlands. These impacts will be concentrated near the treatment plant sites and along the interceptor and outfall corridors. A long-term, adverse impact of the project will be the destruction of woodland habitat at the proposed West Ocean City facility.

Long-term, primary impacts of the applicant's proposed project include a substantial decrease in point-source BOD and suspended solids loading of the Atlantic Ocean

from the North Central Ocean Basin. Nitrogen and phosphorus loading of the near-shore ocean will increase with increasing wastewater flows. Emissions from the incinerator at the Ocean City treatment facility will also increase with increasing wastewater flows.

Secondary environmental impacts resulting from the applicant's proposed project include increased air and water pollution from areal sources, and increased demands for water, recreational facilities and other public services. The Maryland State Highway Administration estimated that relief of congestion along major highways between Ocean City and the Chesapeake Bay Bridges would cost approximately \$200 million. Whitman, Requardt & Associates (1977) indicated that expansion and improvement of the Ocean City water supply system would cost approximately \$5 million. EPA's major concern in the North Central Ocean Basin is the preservation of environmental quality as it may be affected by secondary impacts resulting from land use and social and economic development of the service area. As part of this analysis EPA reviewed local comprehensive plans and supporting ordinances. EPA also identified environmentally sensitive areas which require protection through strong local ordinances (existing and revised) while managed growth proceeds.

4. EPA analyzed numerous alternatives to the applicant's proposed project. These alternatives were evaluated on the basis of environmental and socioeconomic information contained in this statement and cost data presented in the facilities plan. Alternatives evaluated by EPA ranged from specific treatment processes to the concept of regionalization at Ocean City. Nonstructural alternatives and the no action alternative were also evaluated.

Based upon the analysis of component alternatives EPA formulated the following preliminary conclusions:

- The applicant's proposed interceptor system should be phased;
- Effluent from both treatment facilities should be chlorinated rather than ozonated;
- Sludge from the Phase I facilities should be digested and should be applied as a liquid to selected application sites. The initial program should be used to test public acceptance of this disposal alternative. The applicant should evaluate the feasibility of composting all sludge from the Phase II facilities;

- The proposed outfall from the West Ocean City facility across Assateague Island is cost effective and will have minimal impact on the island's ecology and stability. An alternative route across the southern portion of Fenwick Island is also available to the applicant.
- The required treatment capacity for the North Central Ocean Basin in the year 2000 will range from 19.0 to 23.7 mgd rather than 29.5 mgd.

Adoption of these alternatives would permit the applicant to avoid some of the adverse primary and secondary environmental impacts of the proposed project. EPA is providing assistance to the applicant in the further development and implementation of these alternatives.

5. Information used in this EIS was solicited from Federal, state, and local agencies, as well as public and local organizations. A list of the parties contacted during the preparation of the Draft EIS or receiving the Draft EIS for review follows this summary.

DISTRIBUTION LIST

FEDERAL AGENCIES

Advisory Council on Historic Preservation
U. S. Department of Defense
 Army Corps of Engineers
U. S. Department of Transportation
 Federal Highway Administration
 U. S. Coast Guard
U. S. Department of the Interior
 Fish and Wildlife Service
 Bureau of Outdoor Recreation
 Geological Survey
 National Park Service
U. S. Department of Agriculture
 Forest Service
 Soil Conservation Service
U. S. Department of Commerce
 National Oceanic and Atmospheric Administration
 National Marine Fisheries Service
U. S. Department of Health, Education and Welfare
 Public Health Service
U. S. Department of Housing and Urban Development
Water Resources Council
Council on Environmental Quality
Smithsonian Institution
 Chesapeake Bay Foundation for Environmental Studies

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 Resources
 Water Resources
 Administration
Maryland Environmental
 Service

Department of Health and
 Mental Hygiene
 Bureau of Air Quality &
 Noise Control
Environmental Health
 Administration

Maryland Department of State
 Planning

LOCAL AGENCIES

Mayor and Council of Berlin

Town of Ocean City

Worcester County Sanitary
District Commission

Board of County Commissioners

Worcester County Planning and
Zoning Commission

CITIZENS

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Ms. Judith C. Johnson	Mr. & Mrs. William McCabe
Mrs. Ilia J. Fehrer	Mrs. Helen Bunting
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Mr. & Mrs. Earl Crussey, Sr.
Mr. John Trumpower

INTRODUCTION

The following Environmental Impact Statement (EIS) has been prepared pursuant to the National Environmental Policy Act of 1969 (NEPA) [Public Law 91-190] and Executive Order 11514 of March 5, 1970 entitled "Protection and Enhancement of Environmental Quality". Both NEPA and Executive Order 11514 require that all Federal agencies prepare such statements in connection with their proposals for major Federal actions significantly affecting the quality of the human environment. This EIS has also been prepared in accordance with the regulations and guidance established in the Council of Environmental Quality (CEQ) guidelines of August 1, 1973, and in the Environmental Protection Agency (EPA) Final Regulations for the Preparation of Environmental Impact Statements of April 14, 1975. EPA, Region III, Philadelphia, Pennsylvania, is the "Responsible Federal Agency" required by NEPA for this EIS.

This EIS has been prepared on the selected plan of the Facilities Plan for the North Central Ocean Basin, Worcester County, Maryland. The proposed plan includes expansion of the existing Ocean City sewage treatment plant from 12.0 to 20.5 million gallons per day, and construction of a regional sewage treatment plant with a capacity of 8.9 million gallons per day near West Ocean City. Information concerning the proposed project is provided as it was presented to EPA in the Facilities Plan. The purpose of this EIS is to provide meaningful consideration of the environmental impacts of the proposed project rather than of justify previous decisions. This EIS does not dictate the ultimate solution to water quality management plan which will include the service area of the proposed facility.

This statement was prepared to examine the need for increased wastewater treatment capacity in the study area and the environmental impacts, both primary and secondary, which would occur if the proposed project were implemented. Evaluations of the natural environment include the project's impacts upon air quality, water quality, water supply, and environmentally sensitive areas. A complete evaluation of these impacts is provided in Section IV of this statement. The purpose of this evaluation is to insure that providing a means of alleviating public health problems does not create some environmental degradation of equal or greater magnitude.

In accordance with the CEQ and EPA guidelines, this EIS examines the relationship of the proposed action to land use plans, policies and controls in the affected area. This report also examines the population and growth assumptions used to support the project and attempts to determine secondary population and growth impacts resulting from the proposed action and its alternatives.

This EIS evaluates the beneficial and adverse, primary and secondary impacts of the proposed project upon the natural and social environments of the study area. Secondary impacts include the stimulation or inducement of associated investments and changed patterns of social and economic activities as well as impacts on growth and population. This EIS assesses these possible changes in population patterns or growth upon the resource base, including land use, water, air and public services in the affected area.

Despite the fact that some alternatives for wastewater treatment and various identifiable environmental impacts (primary and secondary) may be beyond the explicit regulatory and enforcement authority of EPA, NEPA mandates a full public disclosure of all reasonable alternatives and of their possible environmental impacts. This disclosure and discussion is the intent of this EIS. Since EPA does not have the direct authority to limit land development or to dictate means of land development, the discussion of secondary effects is presented in order that state, county and local governments may evaluate their related pollution problems to insure that environmentally sound solutions for minimizing the future environmental impacts of urban development are ultimately adopted.

In 1975 CEQ requested that the quality and content of EIS's be improved and that their volume be reduced. EPA concurs with this policy. The length of this EIS reflects the complexity of the study area's environmental setting and of the primary and secondary impacts resulting from the applicant's proposed project. In order to aid reviewers of this EIS, EPA has formulated a synopsis of the statement. The synopsis contains a summary discussion of the major sections of the EIS and is arranged in the same sequence as the statement. A review of the synopsis will provide the reader with the principal concepts and conclusions developed in the EIS.

SECTION I

DESCRIPTION OF THE APPLICANT'S PROPOSED ACTION

The following section of this environmental impact statement contains information concerning existing and proposed sewage collection and treatment facilities in the North Central Ocean Basin. The discussion locates the study area and defines the goals and objectives of the applicant's proposed project. The discussion includes a description of existing sewage treatment facilities, their attendant problems and limitations, and describes the proposed modifications to the collection and treatment systems in the study area. Information developed in this discussion will be incorporated into the analysis of the proposed project's environmental impact (Section IV) and into the analysis of feasible alternatives to the applicant's proposed project (Section V).

I. DESCRIPTION OF THE APPLICANT'S PROPOSED PROJECT

A. LOCATION AND IDENTIFICATION OF STUDY AREAS

Study area limits have been established to clarify the discussion of the applicant's proposed project throughout this EIS. These limits were established to confine discussions to geographic areas immediately or potentially affected by the proposed project. The following study areas have been defined for this EIS.

1. Middle Atlantic Region

The general location of the applicant's proposed project in relation to the major rivers of the Middle Atlantic Region is illustrated in Figure I-1. The proposed wastewater collection and treatment facilities and the proposed service areas are included in the Atlantic coastal drainage area of Maryland's "Eastern Shore."

2. Peripheral Study Area

The peripheral study area includes the primary study area and those areas within the "North Central Ocean Basin" as it was designated by George, Miles and Buhr [GMB] (1976) which directly influence the design of the proposed project (Figure I-2). The peripheral study area includes Worcester County west of the Atlantic Ocean, south of the Maryland-Delaware boundary, north of the lower end of Sinepuxent Neck, and west of the drainage divide between the Atlantic Ocean and the Pocomoke River. These area boundaries were determined during the preparation of the Facilities Plan in conjunction with WCSC, the State of Maryland, and EPA. The peripheral study area contains the Berlin 201 planning area and the towns and land areas of Ocean City, West Ocean City, Assateague Island, Sinepuxent Neck, St. Martin Neck, Jenkins Neck, Bishopville, Bishop, and Showell. The entire study area is a portion of the Ocean Coastal Basin defined by the State of Maryland Water Resources Administration (WRA) in its water quality management plan prepared under the authority of section 303(e) of P.L. 92-500.

3. Primary Study Area

The primary study area includes that portion of the peripheral study area which will be served by the applicant's proposed project (Figure I-2). The primary study area includes Ocean City, West Ocean City, the eastern portion of St. Martin Neck, the U.S. Route 50 corridor to Berlin, the Maryland

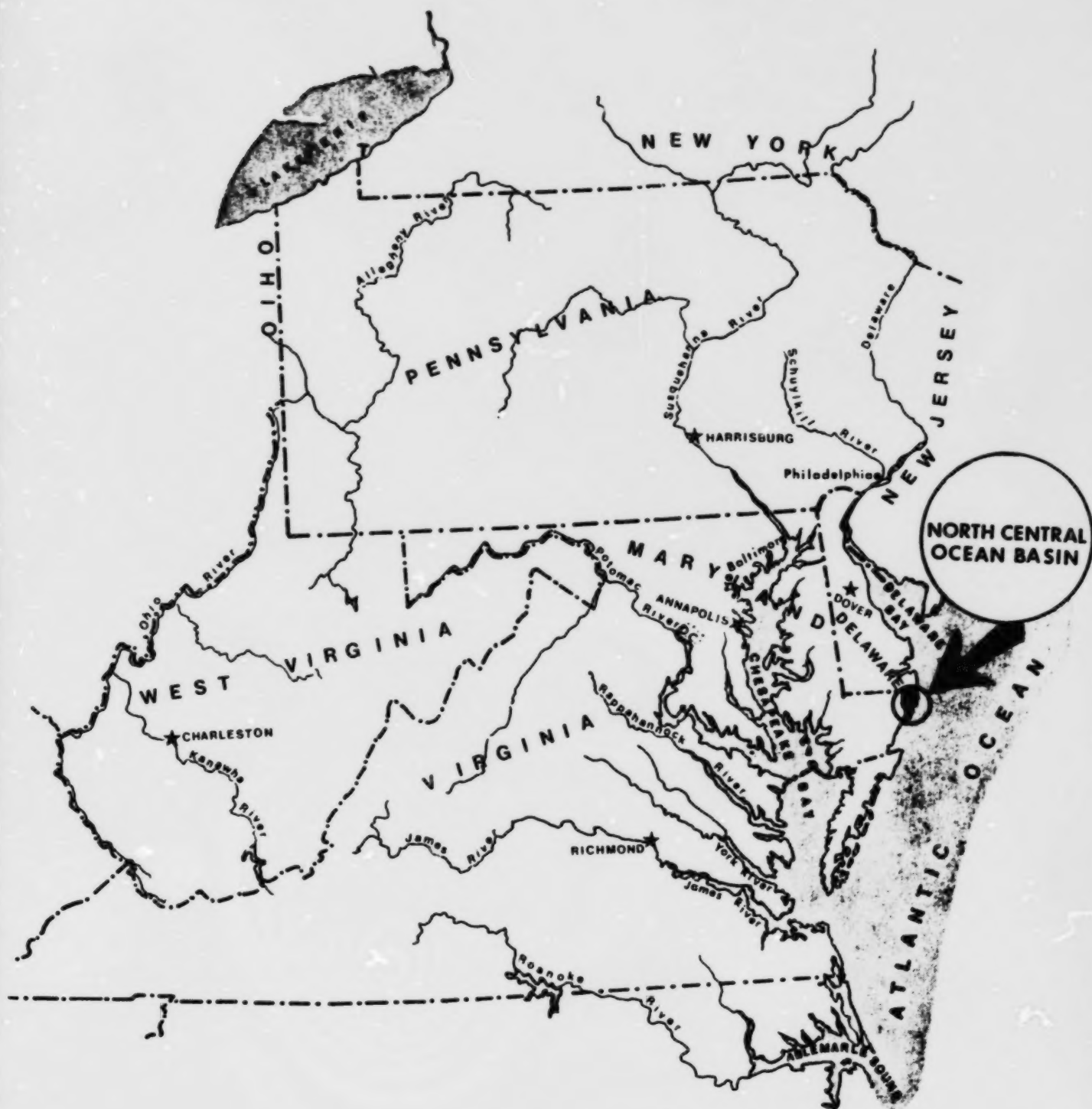
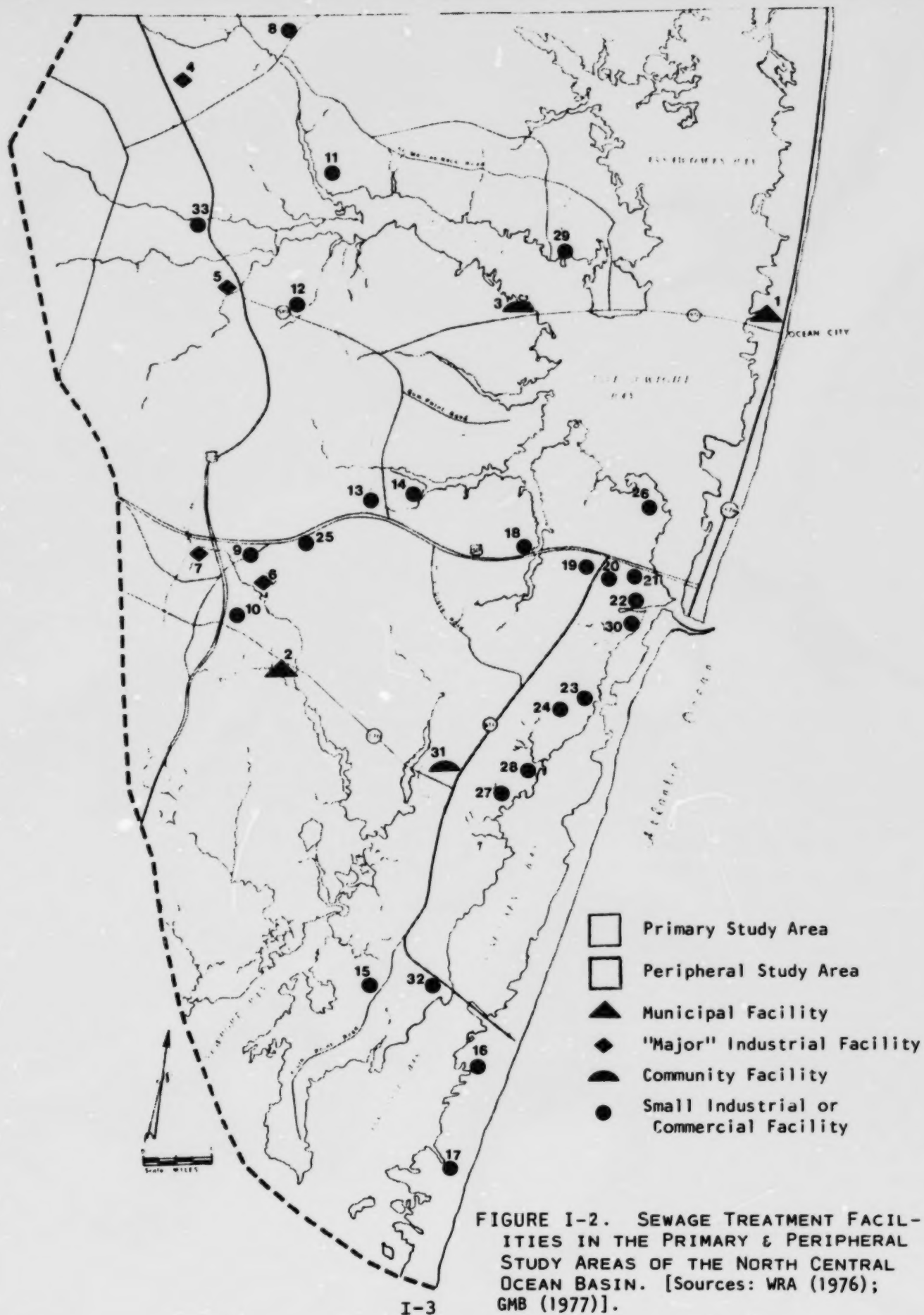


FIGURE I-1. THE MIDDLE ATLANTIC REGION! SHOWING THE GENERAL LOCATION OF THE NORTH CENTRAL OCEAN BASIN, WORCESTER COUNTY, MARYLAND.



Route 611 corridor to near Maryland Route 376, and the Isle of Wight drainage basin to a line slightly west of Maryland Route 589. The Town of Berlin may also be included in the primary study area if the 201 Facilities Plan for the town concludes that entering the applicant's proposed system is cost effective and environmentally satisfactory. The primary study area includes only those areas designated as Ocean City or "Suburban Land" by the Worcester County Land Use Plan (GMB, 1976)

B. EXISTING WASTEWATER TREATMENT FACILITIES

The North Central Ocean Basin contains nine wastewater treatment facilities other than septic systems (Figure I-2; Table I-1). Municipal treatment facilities are located in Ocean City and Berlin. The only major, operational community facility is at Ocean Pines. Industrial facilities with flows equal to or exceeding 50,000 gallons per day are owned by Bishop Processing, Showell Poultry, Chesapeake Foods and Beatrice Foods. In addition, the National Park Service operates a small tertiary treatment plant at the Assateague Island National Seashore headquarters on Sinepuxent Neck. Many small commercial and industrial facilities, most of which discharge wastewater to the ground, are located throughout the basin. Small population centers which are not presently sewerer include West Ocean City, Bishopville and Showell.

1. Municipal Facilities

The Ocean City sewerage system encompasses all of the incorporated areas of Ocean City and has been designated as Worcester County Sanitary District Number One. The wastewater collection system in Ocean City, consists of approximately 323,000 feet of gravity sewers ranging in size from 4 to 42 inches, 7 pumping stations, and approximately 9,000 feet of force mains (GMB, 1976). The first sewers were installed in Ocean City before 1900 and discharged raw sewage from the Boardwalk directly into the Isle of Wight Bay. The 2nd Street sewage treatment plant was built in 1935. At this facility sewage was comminuted, chlorinated, and discharged to the Ocean City Inlet. Between 1935 and 1969, the collection system was extended northward to 27th Street. In 1969 the existing sewage treatment plant was constructed at 64th Street and sewers were installed in the remainder of Ocean City, north to the Maryland-Delaware border. All of the sewers installed before 1900 have been replaced, but most of the lines south of 27th Street remain in the original pipes installed

Table I-1. Sewage Treatment Facilities in the North Central Ocean Basin.
Numbers Correspond to the Locations in Figure I-2. [Source:
WRA (1976)].

<u>Location/Owner of Facility</u>	<u>Type of Treatment</u>	<u>Design Capacity (mgd)</u>	<u>Receiving Stream</u>
<u>Municipal Facilities</u>			
1. Ocean City	Primary	9	Atlantic Ocean
2. Town of Berlin	Secondary	0.6	Trappe Creek
<u>Community Facilities</u>			
3. Ocean Pines	AWT	1.0	Isle of Wight Bay
<u>Major Industrial Facilities</u>			
4. Bishop Processing	Settling Ponds	0.4*	Ground
5. Showell Poultry	Aerated Lagoon	0.9*	South Branch to Shingle Landing Prong
6. Beatrice Foods	Lagoon	1.2*	Trappe Creek
7. Chesapeake Foods	Aerated Lagoon	0.6*	Kitts Branch
<u>Other Point Source Discharges</u>			
8. Showell Growers, Inc.	Settling Basin	0.002*	Ground
9. Abbott Laboratories	- - - -	0.001*	- - - -
10. Berlin A & P	Extended Aeration	0.002*	
11. Timberwycke Estates	Secondary	0.03	Ground
12. Showell Elementary School	Extended Aeration	0.011	Ground
13. Lakehaven Trailer Park	Septic Tanks	0.042	Ground
14. Ocean Downs	Septic Tanks	N.A.	Ground
15. Ocean City Golf & Yacht Club	Septic Tanks	N.A.	Ground
16. Assateague Island State Park	Septic Tanks	0.03	Ground
17. Assateague Island National Seashore North Beach	Septic Tanks	0.017	Ground
18. Nichibei Kai Restaurant	Secondary with Tertiary Filtration	0.012	Ground
19. Francis Scott Key Motel	Septic Tanks	0.007	Ground

Table I-1. Continued.

<u>Location/Owner of Facility</u>	<u>Type of Treatment</u>	<u>Design Capacity (mgd)</u>	<u>Receiving Stream</u>
20. Sea Gull Trailer Park	Septic Tanks	N.A.	Ground
21. Shantytown Marina	Extended Air	0.001	Ground
22. Fisherman's Marina	Septic Tanks	N.A.	Ground
23. Castaways Trailer Park	Septic Tanks	0.012	Ground
24. Eagles Nest Trailer Park	Septic Tanks	N.A.	Ground
25. Stephen Decatur High School	Septic Tanks	0.028	Ground
26. Ocean City Elementary School	Septic Tanks	N.A.	Ground
27. Endless Summer Campground	Septic Tanks	0.020	Ground
28. Frontier Town	Septic Tanks	0.042	Ground
29. Hemphill's Dock	Primary	0.001	St. Martin River
30. Davis & Lynch Fish Company	Primary	0.001	West Ocean City Harbor
31. Pine Pointe Village (Proposed)	Extended Aeration	0.12	Ground
32. Assateague Island National Seashore	Activated Sludge	0.012	Sinepuxent Bay
33. Golden Pride Poultry, Inc.	Settling Basin	0.003*	Ground

* Average wastewater flow.

N.A. = Data not available.

during the 1930's. Because there are few trees in Ocean City, root damage to sewer lines is practically nonexistent. The high water table, combined with deep sewers required by the flat terrain, means that every sewer in Ocean City is below the groundwater level at all times. Ocean City does not have a storm drainage system in most parts of the City. Water collects in the streets during most periods of rainfall, and is discharged into Isle of Wight Bay.

The Ocean City sewage treatment plant provides pre-chlorination, degritting, primary clarification and chlorination (Figure I-3). Effluent is pumped from the facility into the Atlantic Ocean through a 30-inch outfall which extends below grade and natural bottom to a point approximately 3,850 feet from the mean low water elevation. The outfall is oriented approximately perpendicular to the shoreline and effluent is discharged parallel to the shoreline through a diffuser. Approximately half of the effluent is discharged toward the north and half toward the south.

Influent sewage to the Ocean City STP is principally domestic. Operating records from the facility for 1976 indicate that increasing wastewater flows during the summer were accompanied by increasing concentrations of BOD, suspended solids, and settleable matter (Table I-2). Removal efficiencies for BOD and suspended solids also increased with increasing flow and constituent concentration. Based upon four observations of the facility's performance between August 2 and November 22, 1976, the Maryland State Department of Health and Mental Hygiene (DHMH) awarded a "Fair" rating for operational efficiency and "Excellent" rating for operation and maintenance.

The Ocean City STP produces a primary sludge which is incinerated at the treatment plant and disposed of in a landfill. During the winter, October through mid-February, sludge is stored in the clarifiers. This sludge is incinerated during the period from mid-February through March. Incinerator capacity has been increased to 600 lbs of dry solids per hour by treating the sludge with hydrogen peroxide (H_2O_2). The incinerator is operated approximately six days per week from March through September. During 1976 the average number of hours per day that the incinerator was used increased from 5.9 in April to 14.7 in August. WCSC has received no complaints from adjacent property owners concerning operation of the incinerator.

Table I-2. Monthly Mean Influent and Effluent Characteristics Recorded at the Ocean City STP during 1976. [Source: Operational Records Provided by WCSC (1977)].

	Average Flow (mgd)	INFLUENT			EFFLUENT			Peak Flow (mgd)
		BOD ₅ (mg/l)	Suspended Solids (mg/l)	Settleable Matter (ml/l)	BOD ₅ (mg/l)	Suspended Solids (mg/l)	Residual Chlorine (mg/l)	
January	1.26	51	81	3.3	51	57	2.5	2.18
February	1.37	55	92	3.6	47	67	2.3	1.91
March	1.41	37	87	6.8	59	139	2.8	1.89
April	2.12	82	95	6.5	99	105	3.2	3.59
May	2.68	108	102	9.7	143	148	4.3	6.03
June	4.48	157	114	10.2	171	94	4.0	6.08
July	6.34	213	256	14.2	171	112	6.1	7.45
August	7.25	233	328	15.0	166	123	8.3	9.45
September	4.10	177	226	10.4	96	98	5.5	7.01
October	2.40	167	194	6.2	69	79	5.3	4.06
November	1.12	-	-	4.2	76	61	5.1	1.86
December	1.20	-	-	5.5	59	43	5.6	2.04

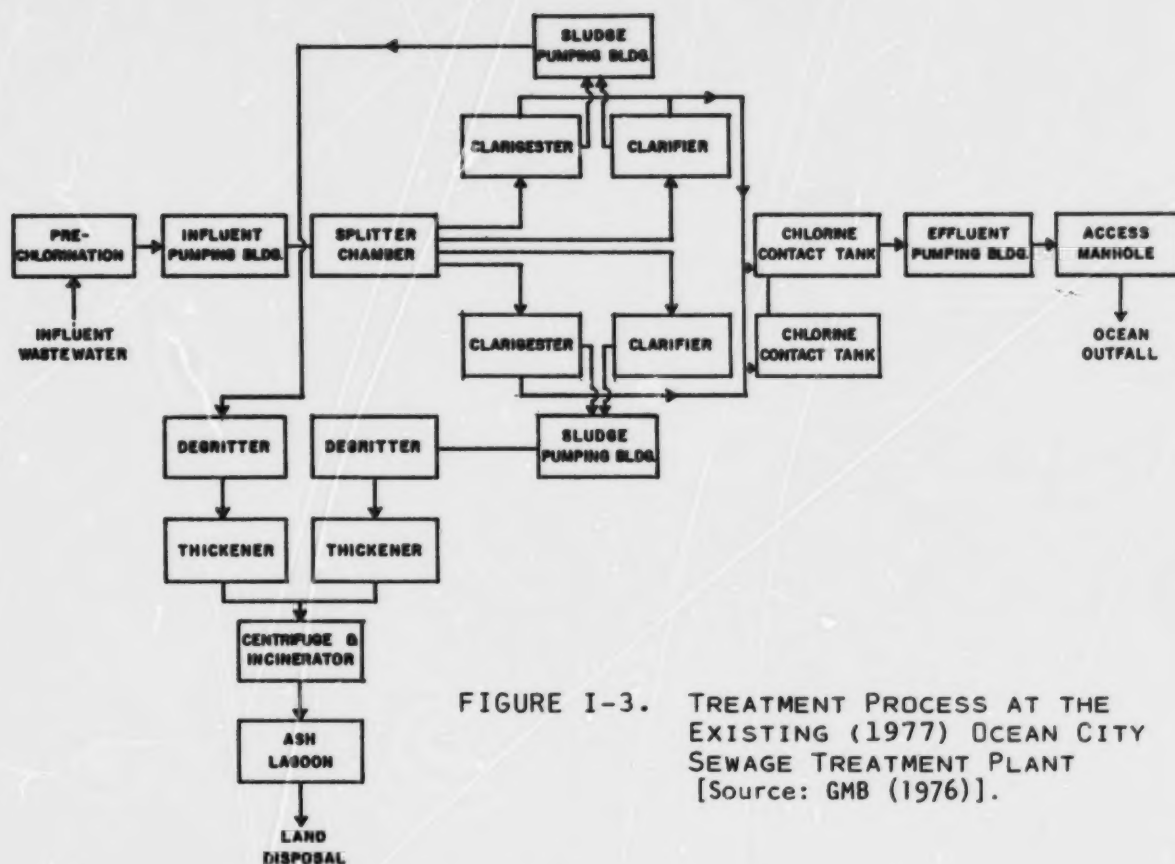


FIGURE I-3. TREATMENT PROCESS AT THE EXISTING (1977) OCEAN CITY SEWAGE TREATMENT PLANT [Source: GMB (1976)].

Operation and maintenance costs for the Ocean City STP and the collection system ranged from \$300,000 to \$350,000 during fiscal 1976 (WCSC, 1977, Personal Communication). The facility is staffed by eight full-time and two maintenance personnel.

A wastewater flow of 12.6 million gallons, recorded on July 26, 1975, is the highest flow ever recorded at the Ocean City STP, and resulted from an intense storm the night of the 25th and 26th during which several inches of rain fell on the City within a few hours.

More than 15,000 feet of the Ocean City collection system were surveyed during February 1974 by Penetryn Systems, Inc., in conjunction with WCSC employees. TV and visual inspections and subsequent review of video tapes indicated no significant portion of the wastewater flow could be attributed to infiltration (GMB, 1976). During the period of the I/I survey, wastewater production averaged 95 percent of the water consumption (GMB, 1976). GMB (1976) proposed that this percentage was justified by the predominance of multi-family housing in Ocean City, and minimal use of water for car washing, lawn watering, and other uses which do not return water

to the sewers. Based upon flow data collected during the survey, GMB (1976) proposed that inflow averages 5.6 percent and infiltration averages 5.3 percent of the average flow to the treatment plant.

Stormwater inflow through manholes has been diminished by placing inserts in cover holes at twelve locations in Ocean City. During intense rains, flooding does become a nuisance. Stormwater from Ocean City is discharged to Isle of Wight and Assawaman Bays.

The Town of Berlin is served by a wastewater collection system which extends throughout the incorporated area. The sewer system consists of approximately 57,700 feet of separate sanitary sewers ranging in size from 8-inch laterals to 15-inch trunk sewers. Three small pumping stations are included in the collection system. The Berlin sewage treatment plant was originally constructed as an Imhoff Tank in 1935. In 1968 the facility was upgraded to provide secondary treatment for 0.6 mgd of wastes. Treatment plant processes currently consist of primary settling, high-rate trickling filtration, secondary settling, sludge drying and transport to landfill and agricultural land, and effluent chlorination. The Berlin STP produces an average of 1.29 dry tons of digested sludge per month. Effluent from the facility is discharged to Bottle Branch of Trappe Creek which is a tributary to Newport Bay. According to WRA (1976), at an average wastewater flow of 0.24 mgd the Berlin STP discharges an average daily load of 50 lbs BOD, 36 lbs TKN, 60 lbs total nitrogen, and 12 lbs total phosphorus.

The Berlin sewerage system currently serves two industrial contributors: The Berlin Milling Company and Sunshine Laundry and Dry Cleaning. Berlin has not enacted a pretreatment ordinance for industrial dischargers.

According to WRA (cited in COE, 1976), the Berlin STP has been hydraulically overloaded periodically due to excessive infiltration-inflow, and the collection system is undersized and inadequate in some areas.

On May 12, 1977 WRA recommended to the Town of Berlin through its design engineer that "discharges from the Berlin Wastewater Treatment Plant be eliminated from Trappe Creek and that the option to connect with regional wastewater treatment facility at Ocean City be exercised". WRA stated further that as a minimum, continued discharge to Trappe Creek would require phosphorus removal to 0.3 mg/l or

nitrogen removal to 3 mg/l. WRA is also considering modification of existing BOD and suspended solids limits. Preliminary cost estimates for alternatives available to the town indicated that the greatest cost would be incurred if land application of the effluent were selected. The least costly alternative was connecting with the regional collection system.

2. Community Facilities

Ocean Pines is a planned community on the western shore of Isle of Wight Bay (Jenkins Neck). The community, which has an ultimate capacity of 8,000 to 10,000 dwelling units, is served by a community sewerage system. The sewer system is owned and operated by Maryland Marine Utilities, Inc. The collection system consists of small-diameter vacuum lines which convey wastewater from holding tanks to the treatment plant. The 1 mgd treatment plant provides advanced wastewater treatment through the use of the activated sludge process followed by setting, filtration, phosphorus removal, and chlorination. According to WRA (1976) average wastewater flows to the plant in 1975 increased from 0.1 mgd in the winter to 0.4 mgd during the summer. Effluent is discharged to the St. Martin River at its confluence with Isle of Wight Bay. Constituent loading is proportional to effluent flow (Table I-3).

Table I-3. 1975 Average Wastewater Flows and Constituent Loads from The Ocean Pines Sewage Treatment Plant. [Source: WRA (1976)].

	<u>Winter</u>	<u>Summer</u>
Wastewater Flow (mgd)	0.1	0.4
BOD (lbs/day)	4	17
Total Kjeldahl Nitrogen (lbs/day)	12	50
Total Nitrogen (lbs/day)	20	83
Total Phosphorus (lbs/day)	5	20

Ocean Pines has requested and received a permit to discharge 4 mgd into St. Martin River. Nitrogen removal is required as part of the facility's wasteload limitation.

Mystic Harbour was a small planned community on Upper Sinepuxent Neck. The developer of the community recently defaulted, and receivers of the property are purchasing previously sold properties in the community.

3. Industrial Facilities

Four "major" industrial wastewater sources have been identified in the North Central Ocean Basin (GMB, 1976) (Figure I-2). "Major" industrial facilities are defined as those with discharges exceeding 50,000 gallons per day (gpd). All of the major industrial facilities treat wastes from poultry processing or rendering operations.

Bishop Processing treats an average wastewater flow of 0.4 mgd using settling ponds and containment with ground discharge. Major structural problems have resulted in direct wastewater discharge into Carey Branch. Attorney General action concerning the facility is pending (GMB, 1976).

Showell Poultry treats approximately 0.9 mgd using an aerated lagoon, biological stabilization ponds, and disinfection. Effluent is discharged to the South Branch of Shingle Landing Prong. According to WRA (1976), average daily loads of BOD, total nitrogen, and total phosphorus from the facility are 750 lbs, 300 lbs, and 75 lbs, respectively. The facility is being upgraded to comply with final effluent limitations.

Chesapeake Foods treats an average wastewater flow of 0.5 mgd. Treatment processes include air flotation, aerated lagoon, stabilization ponds, and chlorination. Effluent from the facility is discharged into Kitts Branch, a tributary of Trappe Creek. According to WRA (1976) average daily loads of BOD, total nitrogen, and total phosphorus from the facility are 300 lbs, 200 lbs, and 50 lbs, respectively. The facility must be upgraded to comply with final effluent limitations. However, the facility may be connected with the Berlin collection system and its wastewater treated at Berlin or a proposed regional facility. A decision concerning these alternatives will be made as part of the Berlin and the North Central Ocean Basin facilities plans.

Beatrice Foods treats approximately 1.2 mgd of wastewater using an aerated lagoon and stabilization ponds. Effluent is discharged to Trappe Creek. According to WRA (1976) the facility discharges an average of 47.5 lbs of BOD per day into the creek. The company has ordered a pressure filter and alum addition equipment to produce an effluent in compliance with its NPDES permit limitations.

4. Minor Point Source Discharges

WRA (1975) included approximately 26 industrial, commercial, and community facilities in its inventory of the North Central Ocean Basin (Table I-1; Figure I-2). These facilities have a combined treatment capacity of approximately 0.4 mgd. Most of these facilities are included in the proposed regional sewerage system (GMB, 1976). Only three of the facilities discharge effluent directly to surface waters; the remainder rely upon septic systems or other land disposal techniques.

Virtually all of the wastewater generated outside of existing sewerage areas in the Basin is disposed of through septic tank and tile drain systems (GMB, 1976). The poor suitability of soils combined with seasonally high water tables and close proximity to the coastal bays has resulted in the failure of many septic tank systems. GMB (1976) reported that many septic tank failures were also resulting from lack of appropriate maintenance and/or poor design. WRA (1976) reported that in 1970 approximately 5,275 year-round housing units utilized septic tanks, cesspools, and other on-site disposal techniques. An average of 350 septic tank permits are issued annually in the County. Approximately 200 to 250 of the septic systems are subject to failure (WRA, 1976), and most of these are in the Ocean Basin. DHMH (1975) designated five areas in the North Central Ocean Basin as "Failing Septic Tank Areas In Need of Sewerage" (Existing and Projected Failures By 1990) (Figure I-4). These areas include West Ocean City, Snug Harbor, Assateague Island State Park, Berlin vicinity, and Bishopville. GMB (1976) reported that West Ocean City was the most critical area of failing septic systems in the Basin and had been formed into a sanitary district. A collection system has been designed for the area through a grant provided by the State of Maryland Failing Septic Tank Grant Program.



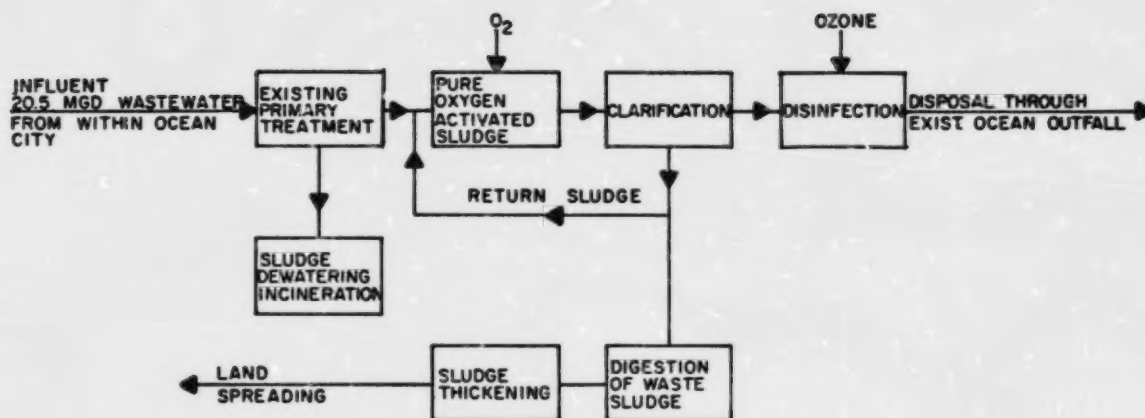
C. APPLICANT'S PROPOSED PROJECT

As a conclusion of the Facilities Plan for the North Central Ocean Basin, GMB (1977) recommended that the WCSC provide approximately 29.4 mgd of secondary treatment capacity at two separate facilities. GMB recommended that rural areas in the basin be served by individual septic systems. The major components of the wastewater treatment plan for the North Central Ocean Basin include the expanded Ocean City STP, The Mainland STP, the collection system, and individual septic systems in the rural areas of Showell, Bishop, and Bishopville.

1. Ocean City Sewage Treatment Plant

GMB (1976) recommended expanding the existing Ocean City STP from its present treatment capacity of 9 mgd to 20.5 mgd. EPA recently permitted WCSC to expand the 9 mgd facility to 12 mgd and to upgrade the facility to provide secondary treatment to the wastewater. The costs of this expansion are included in GMB's (1977) Alternative 2-Phase I. Expansion of the facility from 12.0 to 20.5 mgd would be Phase II of the plan and would be complete by 1985. According to GMB (1976) secondary treatment at 20.5 mgd would be provided by the pure-oxygen modification of the activated sludge treatment process (Figure I-5). Effluent would be disinfected through ozonation and would be discharged to the Atlantic Ocean through an extension of the existing outfall. Primary sludge from the facility would be incinerated in the existing incinerator. Secondary sludge would be disposed of through land spreading. The applicant has not determined the site of land spreading. The preliminary capital cost estimates for this component of the Facilities Plan is approximately \$24.9 million (Table I-4). Annual operation and maintenance costs for the treatment and disposal facilities are projected to increase from \$642,200 for the 12 mgd facility to \$1,190,500 for the 20.5 mgd facility (Table I-4).

WCSC had intended to provide land for the treatment units required for 20.5 mgd treatment capacity by filling 7.5 acres of Isle of Wight Bay and two small portions of marsh behind the existing facility. Filling would extend to the "bulkhead line" established by Ocean City and would require approximately 300,000 cubic yards of fill material. The original Corps of Engineers filling permit for this portion of the project has expired and must be renewed. EPA has tentatively rejected the concept of any filling in Isle of Wight Bay. Preliminary negotiations between WCSC and "Playland", an adjoining property, have lead WCSC to conclude that procuring the playground would cost approximately \$3 million.



20.5 MGD OCEAN CITY FACILITY

FIGURE I-5. TREATMENT PROCESS AT THE PROPOSED OCEAN CITY SEWAGE TREATMENT PLANT. [Source: GMB (1977)].

Table I-4. Capital and Annual O&M Costs of the Principal Components and Phases of the Proposed Ocean City Sewage Treatment Plant. [Source: GMB (1977)].

<u>Component</u>	<u>Capital Costs</u>	
	<u>Phase I (1980)</u> <u>(9 to 12 mgd)</u>	<u>Phase II (1985)</u> <u>(12 to 20.5 mgd)</u>
Wastewater Treatment Units	\$ 8,471,000	\$ 6,887,700
Land (Plant Site)	0	317,200
Sludge Treatment Units	1,092,100	887,900
Land (Sludge Disposal)	765,000	541,600
Ocean Outfall Extensions	0	1,800,000
Subtotal	\$10,328,100	\$10,434,400
Contingencies & Engineering (20%)	2,065,620	2,086,880
Total	\$12,393,720	\$12,521,280

Table I-4 - Cont'd.

Annual Operation & Maintenance Costs

<u>Component</u>	<u>Phase I</u>	<u>Phase II</u>
Wastewater Treatment	\$355,700	\$292,000
Sludge Treatment & Disposal	237,500	180,300
Effluent Disposal	<u>49,000*</u>	<u>76,000**</u>
Total	\$642,200	\$548,300

* 1980 - 1990.

** 1990 - 2000.

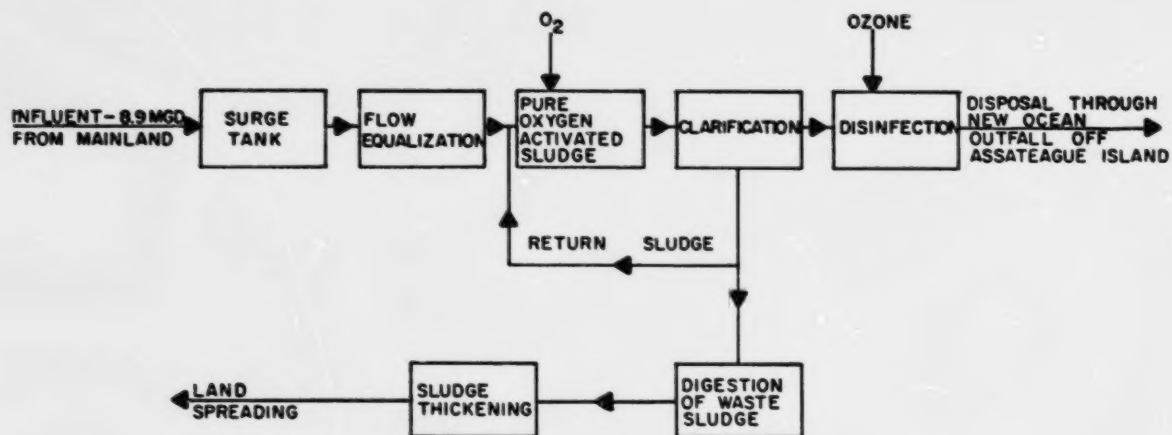
Total O&M at 20.5 mgd is approximately \$1,190,500 (\$642,200 + \$548,300).

The service area of the expanded Ocean City STP will include only the Fenwick Island portion of the study area. The plan does not include significant expansion of the collection system. As proposed by GMB (1976), the Ocean City portion of the collection and treatment system would not be connected with the Mainland system.

2. Mainland Sewage Treatment Plant

GMB (1977) recommended that an 8.9 mgd treatment facility be constructed in Upper Sinepuxent Neck. The facility would serve those areas included in the proposed regional sewage collection system (following discussion). In response to citizen concern about potential growth inducement in the agricultural areas around Bishop, Showell, and Bishopville, GMB and WCSC removed these areas from the service area of the proposed mainland STP.

The Mainland STP would provide secondary treatment to wastewater through the pure-oxygen modification of activated sludge process (Figure I-6). Effluent would be disinfected through ozonation and discharged to the Atlantic Ocean. The proposed outfall would cross the Ocean City Airport property, Sinepuxent Bay, Assateague Island, and would extend 6,000 feet into the Ocean (Figure I-7; Page I-19). Primary and secondary sludges from the facility would be digested and disposed of through land spreading. The applicant has not selected a site for land spreading.



8.9 MGD MAINLAND FACILITY

FIGURE I-6. TREATMENT PROCESSES AT THE PROPOSED MAINLAND SEWAGE TREATMENT PLANT. [Source: GMB (1977)].

In 1977 GMB proposed that the Mainland STP be constructed in two phases. Phase I would include construction of a 6 mgd treatment facility and the ocean outfall. The capital cost of Phase I was anticipated to be approximately \$17.9 million and annual operation and maintenance costs were projected to be \$403,100 (Table I-5, Page I-21). Construction of the Phase I facility would be completed by 1980. Phase II would include expansion of the 6 mgd facility to a capacity of 8.9 mgd. The capital cost for this expansion would be approximately \$5.1 million, and annual operation and maintenance costs for the 8.9 mgd facility would be \$660,500. Phase II construction would be completed by 1985.

3. Regional Collection System

GMB (1976) proposed a regional wastewater collection system to convey sewage from Berlin, the Route 611 corridor, West Ocean City, Isle of Wight, and the Turville-Jenkins Neck area to the Mainland STP (Figure I-8, Page I-20). The currently proposed collection system is a modification of alternative #2 of the preliminary Facilities Plan. The modifications are the removal of the regional collection system from the northwest portion of the Basin, and the proposed connection to the Isle of Wight in 1985 rather than 1980. Total Capital costs for the regional collection system will be approximately \$11 million (Table I-6, Page I-22). Annual operation and maintenance costs would increase from \$80,500 in 1985 to \$108,900 in 1995.

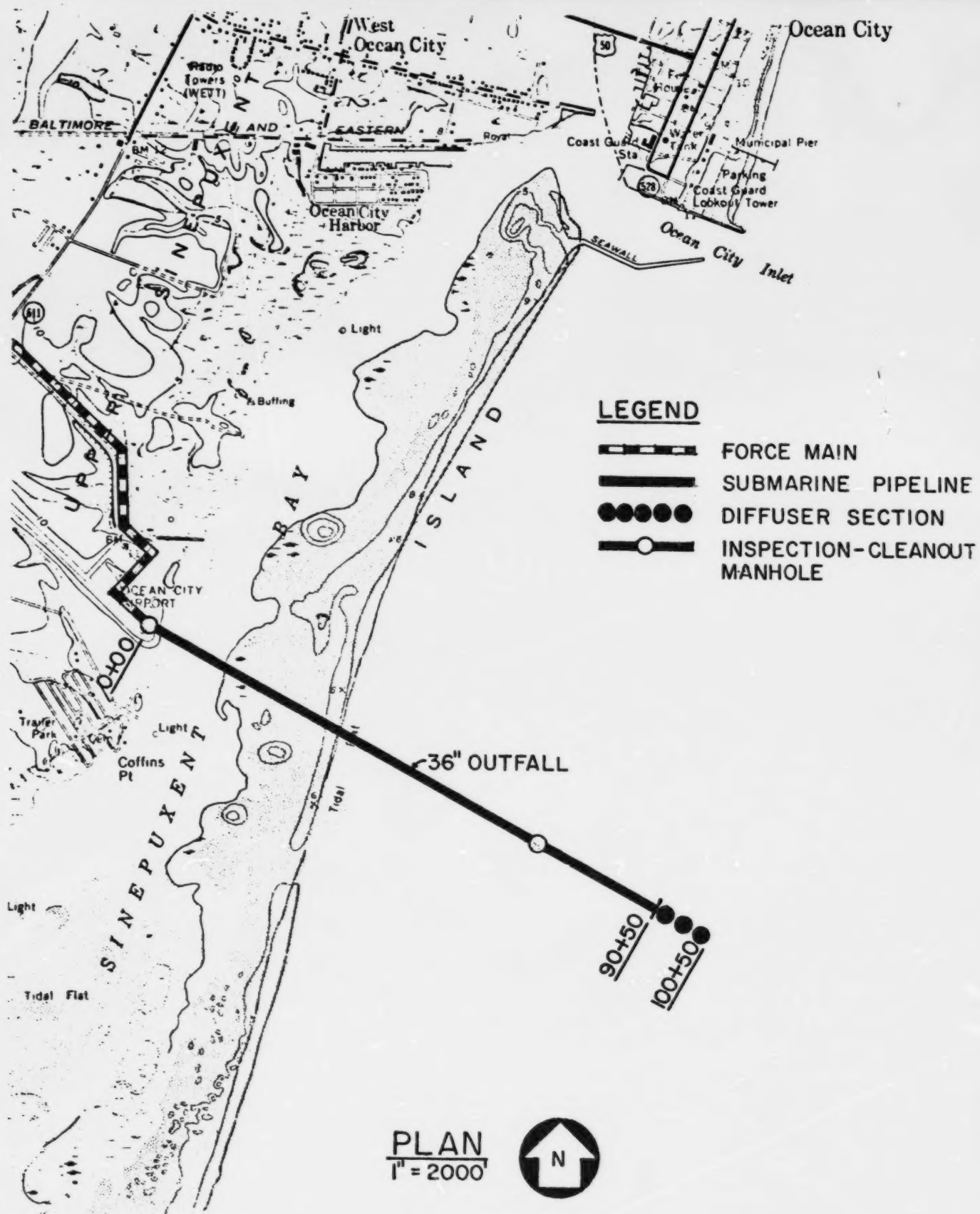


FIGURE I-7. PROPOSED OCEAN OUTFALL FROM THE MAINLAND SEWAGE TREATMENT PLANT. [Source: GMB (1977)].

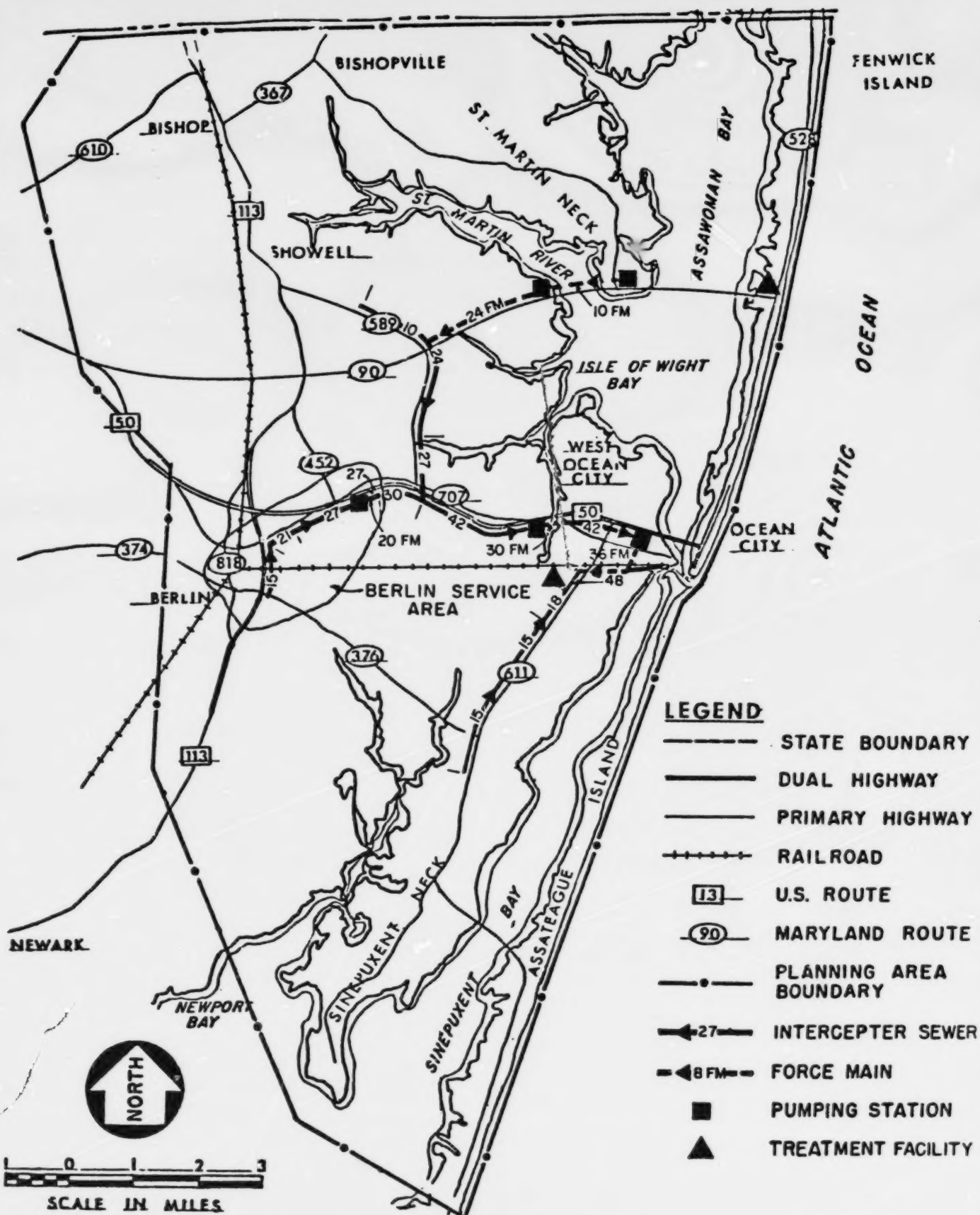


FIGURE I-8. PROPOSED REGIONAL SEWAGE COLLECTION SYSTEM.
[Source: GMB (1977)].

Table I-5. Capital and Annual O&M Costs of the Principal Components and Phases of the Proposed Mainland Sewage Treatment Plant. [Source: GMB (1977)].

<u>Capital Cost</u>		
<u>Component</u>	<u>Phase I (1980)</u> <u>(0 to 6 mgd)</u>	<u>Phase II (1985)</u> <u>(6 to 8.9 mgd)</u>
Wastewater Treatment Units	\$ 5,591,500	\$3,616,100
Land (Plant Site)	67,500	0
Sludge Treatment Units	720,700	465,800
Land (Sludge Disposal)	382,500	185,000
Ocean Outfall	<u>8,150,000</u>	<u>0</u>
Subtotal	\$14,912,200	\$4,266,900
Contingencies & Engineering (20%)	<u>2,982,440</u>	<u>853,380</u>
Total	\$17,894,640	\$5,120,280

<u>Annual Operation & Maintenance Costs</u>		
<u>Component</u>	<u>Phase I</u>	<u>Phase II</u>
Wastewater Treatment	\$260,400	\$146,100
Sludge Treatment & Disposal	136,300	86,300
Effluent Disposal	<u>6,700*</u>	<u>25,000**</u>
Total	\$403,100	\$257,400

* 1980 - 1990.

** 1990 - 2000.

Total O&M at 8.9 mgd is approximately \$660,500 (\$403,100 + \$257,400).

4. Local Collection Systems

GMB (1977) proposed that sanitary districts be established in Upper Sinepuxent Neck, Ocean Pines, and the Turville-Neck - Route 50 Corridor by 1980 to prepare for local wastewater collection in these areas. A sanitary district would be established on Isle of Wight by 1985. Berlin was not included in the GMB (1977) list. However, if that area were included in the regional collection system, it would also become a sanitary district.

Local collection systems for the two existing sanitary districts, Ocean City and West Ocean City, were included in the 1977 Facilities Plan. Capital costs for expanding the

Table I-6. Capital and Annual O&M Costs of the Principal Components of the Proposed Regional Wastewater Collection System.
[Source: GMB (1977)].

<u>Segment</u>	Capital	Operation & Maintenance Costs	
	<u>Cost (1980)</u>	<u>1985</u>	<u>1995</u>
Isle of Wight to Ocean Pines (1985)	\$ 875,900	\$ 1,200	\$ 3,000
Ocean Pines to U.S. Route 50	1,505,000	10,200	14,800
Berlin to Md. Route 589	1,113,000	7,800	9,400
Md. Route 589 to West Ocean City	2,341,000	19,700	25,800
West Ocean City to Railroad	1,063,000	40,300	54,400
Railroad & Sinepuxent Neck to Mainland STP	<u>\$ 2,106,000</u>	<u>1,300</u>	<u>1,500</u>
Subtotal	\$ 9,003,900	\$80,500	\$108,900
Contingencies & Engineering (20%)	<u>1,800,000</u>		
Total	\$10,804,700		

Ocean City collections system would be \$5,250,000, and annual operation and maintenance costs would increase from \$21,000 in 1985 to \$27,600 in 1995. Installation of a collection system in West Ocean City would cost \$5,117,500, and annual operation and maintenance costs would increase from \$38,500 in 1985 to \$46,000 in 1995.

5. Rural Communities, Parks and Industries

GMB (1976) recognized that several wastewater sources of concern or areas with failing septic systems are situated outside of the primary study area (Figure I-2). These points include the towns of Bishopville, Showell, and Bishop, the State and Federal Parks on Assateague Island, and Showell Poultry, Chesapeake Foods, and Bishop Processing.

Following an analysis of costs, soil capabilities, and reasons for previous septic tank failures, GMB (1976) concluded that the use of conventional septic systems should continue in the towns of Bishopville, Showell, and Bishop. GMB (1976) proposed that:

- Soils in these three communities are generally favorable for septic tank operation.
- Septic tank failures have generally resulted from a lack of maintenance and some homes in the Bishopville area are discharging raw sewage to surface waters.
- Individual septic systems are the most cost-effective method of wastewater management in these communities.
- Community or cluster systems could possibly induce undesirable development in these rural areas.

GMB proposed that septic tanks be maintained on Assateague Island and that a small spray irrigation system replace the Sinepuxent Bay discharge from the 12,000 gpd park headquarters treatment system.

GMB proposed that Showell Poultry continue to upgrade its treatment system efficiency to satisfy the final NPDES permit limitations rather than request connection to the proposed central sewerage system. Connection to the central system would cost approximately \$3.2 million, require further pretreatment costs, and require the installation of sewers in a rural area.

Chesapeake Foods was advised to connect with the central sewerage system in Berlin. Costs of connecting to a central system plus pretreatment costs were less than the costs required to upgrade the existing treatment facility to satisfy its NPDES permit. In addition, the discharge from this point source would be eliminated from the coastal bay system.

Bishop Processing was advised to provide treatment to its wastes before discharging them to existing infiltration ponds. The \$1.9 million cost of connection to the regional system did not include pretreatment costs (GMB, 1976). Connection to the regional system was considered to be non-cost effective.

D. GOALS AND OBJECTIVES OF THE PROPOSED PROJECT

GMB (1975) defined the following goals in the Comprehensive Plan for Water and Sewerage Systems: Worcester County, Maryland.

- To provide sewerage facilities which are consistent with the county comprehensive plan.
- To protect the health, safety and welfare of all the people residing in Worcester County by maintaining and/or providing adequate water and sewerage systems.
- To encourage and control urban development in the county so that it may be concentrated in areas where central water and sewerage systems are available, or can reasonably be provided when required. Conversely, it is the intent to discourage high density development in areas which cannot be so served.
- To protect and maintain in agricultural use such areas of the county as are now in such use and are demonstrably best suited for such use.
- To identify and categorize sources of pollution from urban and rural areas, and from industry.
- To preserve and improve the quality of bay waters.

In addition, WRA (1976) defined the following goals in the Ocean Coastal Basin: Water Quality Management Plan.

- Protect the health, safety, and welfare of all people residing in Worcester County by maintaining and/or providing adequate water and sewerage systems.
- Preserve and improve the quality of bay waters.
- Support population distribution and land use management designed to accomodate a diversity of urban and rural life styles.
- Provide central sewerage service to designated development areas in accordance with county priorities which are consistent with other public facility needs.
- Meet the public service needs of existing development as a first priority.

- Encourage and control urban development in the county so that it may be concentrated in areas where central water and sewerage systems are available, or can reasonably be provided when required. Conversely, to discourage high density development in areas which cannot be so served.
- Encourage resort facilities, seafood, and other important industries to provide adequate wastewater treatment in order to maintain water quality.

In order to attain its goals, WRA (1976) formulated a discharge policy for the Ocean Coastal Basin. That policy states that all existing and future wastewater discharges in the basin shall:

- Consider the allocable waste assimilation capacity of the coastal bays to be minimal and no new direct surface discharges of treated wastewater will be allowed to the coastal bays;
- Remove all existing direct surface discharges to the coastal bays to the extent consistent with current discharge permits, with sewerage service as directed by the Worcester County Land Use Plan, and with the County Comprehensive Water and Sewerage Plan;
- Utilize Section 201 facility planning, for publicly-owned facilities, to thoroughly assess the cost effectiveness of land disposal and other ground discharge alternatives to existing discharges to the bays and tributaries, and of proper treatment and wastewater discharge to the Atlantic Ocean; and
- Meet stringent effluent discharge limitations as determined through wasteload allocation analysis and testing by WRA and reflected in NPDES permits.

SECTION II

ENVIRONMENTAL SETTING

The following section of this environmental impact statement contains a description of the physical and the social and economic environments of the North Central Ocean Basin. The environmental setting is discussed in the following subsections:

Physical Environment

- Climate
- Air Quality
- Geology and Groundwater
- Topography and Soils
- Hydrology and Water Quality
- Terrestrial and Aquatic Communities
- Noise

Social and Economic Environment

- Population
- Land Use
- Economy
- Public Services
- Historic and Archaeological Resources
- Aesthetics

Environmentally Sensitive Areas

Information developed in this discussion is incorporated into the analysis of the environmental impact of the proposed project (Section IV) and the analysis of alternatives to the proposed project (Section V).

II. ENVIRONMENTAL SETTING

A. Physical Environment

The physical environment setting of the North Central Ocean Basin and the constraints of natural features of the area upon future development are described in the following sections. This information provides the basis for evaluating many of the environmental impacts which would result from the applicant's proposed project.

1. Climate

The National Weather Service does not operate a weather monitoring station in Ocean City. However, climatological data are available from Snowhill and Salisbury, Maryland and Rehoboth Beach, Delaware. Data from these monitoring stations have been combined to provide a data base for the entire study area.

The Delmarva Peninsula has a humid mesothermal climate influenced by maritime tropical air masses in the summer and by continental polar air masses in the winter (COE, 1976). The Peninsula is in the zone of prevailing westerlies where most high- and low-pressure weather systems move from west to east. Weather systems are normally most intense during the winter when rapidly moving storm fronts and outbreaks of cold polar air are prevalent. Although summer weather patterns are also variable, stable high-pressure systems tend to dominate the climate, and low-pressure cells are weak and infrequent.

The average annual air temperature in the study area is 56.5°F (Table II-1). The warmest period of the year is normally during late July when temperatures average 90°F during the afternoon. The coldest period of the year is normally during late January and early February when the minimum temperature during the morning averages 26°F. Temperatures of 32°F or less normally occur during 90 days throughout the winter. During the summer, the land-sea breeze system produces gentle onshore breezes during the day and offshore breezes during the night. This has the effect of lowering daily temperatures along coastal areas while areas further inland experience higher temperatures.

The average annual precipitation in the study area is approximately 47 inches (Table II-2). Precipitation is normally distributed evenly throughout the year but is

Table II-1. Average Air Temperatures, in Degrees Fahrenheit, at Salisbury and Snow Hill, Maryland, and Rehoboth Beach, Delaware. [Source: Hall (1970); Hall (1973); DSPO (1970)].

<u>Month</u>	<u>Salisbury</u>	<u>Snow Hill</u>	<u>Rehoboth Beach</u>	<u>Average</u>
January	38.7	38.1	36.1	37.6
February	39.4	38.7	36.8	38.3
March	45.6	44.7	43.7	44.7
April	55.6	54.6	53.1	54.4
May	65.2	64.1	61.8	63.7
June	73.4	72.6	70.7	72.2
July	77.3	76.6	75.3	76.4
August	76.1	75.2	73.7	75.0
September	69.8	69.3	67.9	69.0
October	59.3	58.9	58.3	58.8
November	49.3	48.3	48.1	48.6
December	39.6	39.3	37.7	38.9
Annual	57.5	56.7	55.4	56.5

Table II-2. Total Precipitation, in Inches, Recorded at Salisbury and Snow Hill, Maryland, and Rehoboth Beach, Delaware. [Source: Hall (1970); Hall (1973); DSPO (1970)].

<u>Month</u>	<u>Salisbury</u>	<u>Snow Hill</u>	<u>Rehoboth Beach</u>	<u>Average</u>
January	3.66	3.94	3.61	3.74
February	3.21	3.43	3.25	3.30
March	4.31	4.62	4.04	4.32
April	3.34	3.61	3.31	3.42
May	3.62	3.61	3.99	3.74
June	3.49	3.80	3.85	3.73
July	4.39	5.12	4.57	4.69
August	6.01	5.67	4.95	5.54
September	4.44	4.50	3.58	4.17
October	3.50	3.91	3.15	3.52
November	3.21	3.55	3.86	3.54
December	3.13	3.41	3.63	3.39
Annual	46.13	49.17	45.47	46.92

generally greatest during August. The average annual snowfall is 16.0 inches at Rehoboth Beach, 12.4 inches at Salisbury, and 11.7 inches at Snow Hill. During the warmer half of the year, precipitation is often intense in local areas and causes flooding problems. Thunderstorms occur during an average of 32 days each year, and two-thirds of these storms occur during June, July and August.

The prevailing wind in the area is from the west to northwest, except during the summer when it is southerly. The average wind speed is 8 to 10 miles per hour. Winds equal to or exceeding 50 miles per hour may accompany severe thunderstorms. Tornadoes are rare. The hurricane season begins in June and often extends into November. Most hurricanes pass the study area well offshore and damage is usually restricted to that associated with heavy rain, high tides, and high seas. Many hurricanes struck the area during the mid-1950's, but during the 1960's, the area was relatively free of these storms. Northeast storms which occur primarily during the fall and winter are a more significant cause of erosion along the coastal area than the summer hurricanes. The storms are accompanied by heavy rain and strong northeast winds which may cause unusually high tides and seas. Duration of the storms is variable but they usually persist for 2 to 5 days.

The mean total annual pan evaporation measured at Salisbury from 1950-1953 was 54.23 inches (Rasmussen et al., 1955) and exceeded the total annual precipitation for the area. The lowest monthly mean pan evaporation, 0.93 inches, was recorded during December, 1955, and highest monthly pan evaporation, 9.44 inches, was recorded during July, 1953. These data are considered to be representative of the entire study area. Evapotranspiration in the area is also seasonal phenomenon. The lowest rates, less than one inch per month, occur during the winter, and the highest rates, greater than four inches per month, occur during July and August (Bogges and Heidel, 1968).

Normally, the area receives sunshine approximately 60 percent of the maximum time possible throughout the year, but the average ranges from 55 percent during the winter to 65 percent during the summer. During a normal year, heavy fog occurs during 35 days in the area.

2. Air Quality

The State of Maryland does not maintain an air-quality monitoring station in the North Central Ocean Basin. However, the Basin is included within the Maryland Eastern Shore Intrastate Air Quality Control Region (AQCR) defined by the Bureau of Air Quality and Noise Control (BAQNC). EPA established a priority system to classify AQCR's for the purpose of air-quality planning and evaluation (Table II-3).

Table II-3. Concentration Limits for Air Quality Control Region Priority Classes. [Source: EPA (1976)].

	<u>Limit ($\mu\text{g}/\text{m}^3$)</u>		<u>Priority III, Less Than</u>
	<u>Priority II</u>		
	<u>From</u>	<u>To</u>	
SULFUR OXIDES			
Annual Arithmetic Mean	60	100	60
24-Hour Maximum	260	455	260
3-Hour Maximum	1,300	-	1,300
PARTICULATE MATTER			
Annual Geometric Mean	60	95	60
24-Hour Maximum	150	325	150
CARBON MONOXIDE			
8-Hour Maximum	--		14,000
1-Hour Maximum	--		55,000
NITROGEN DIOXIDE			
Annual Arithmetic Mean	--		110
PHOTOCHEMICAL OXIDANTS			
	--		195

An AQCR is classified according to the worst air quality within the region. The Eastern Shore AQCR has been classified in Priority III for all pollutants except suspended particulates for which it has been classified as Priority II. Air quality within the Basin is considered good and not of major concern.

Air pollutant emissions in Worcester County in 1971 were estimated by BAQNC (1976) (Table II-4). Major line emission sources include the corridors along U.S. Routes 50 and 113; and Maryland Routes 90, 376, 611, and 528 (COE, 1976) (Figure II-1). BAQNC did not list any point sources of concern in Worcester County in its 1975 Emissions Inventory.

Maryland has adopted the national ambient air quality standards established by EPA except for sulfur oxides and particulates for which more stringent standards have been established (BAQNC, 1975) (Table II-5). These standards are divided into two levels of protection. Primary (serious) ambient air quality standards are defined as levels of air quality necessary to protect public health. Secondary ambient air quality standards are defined as

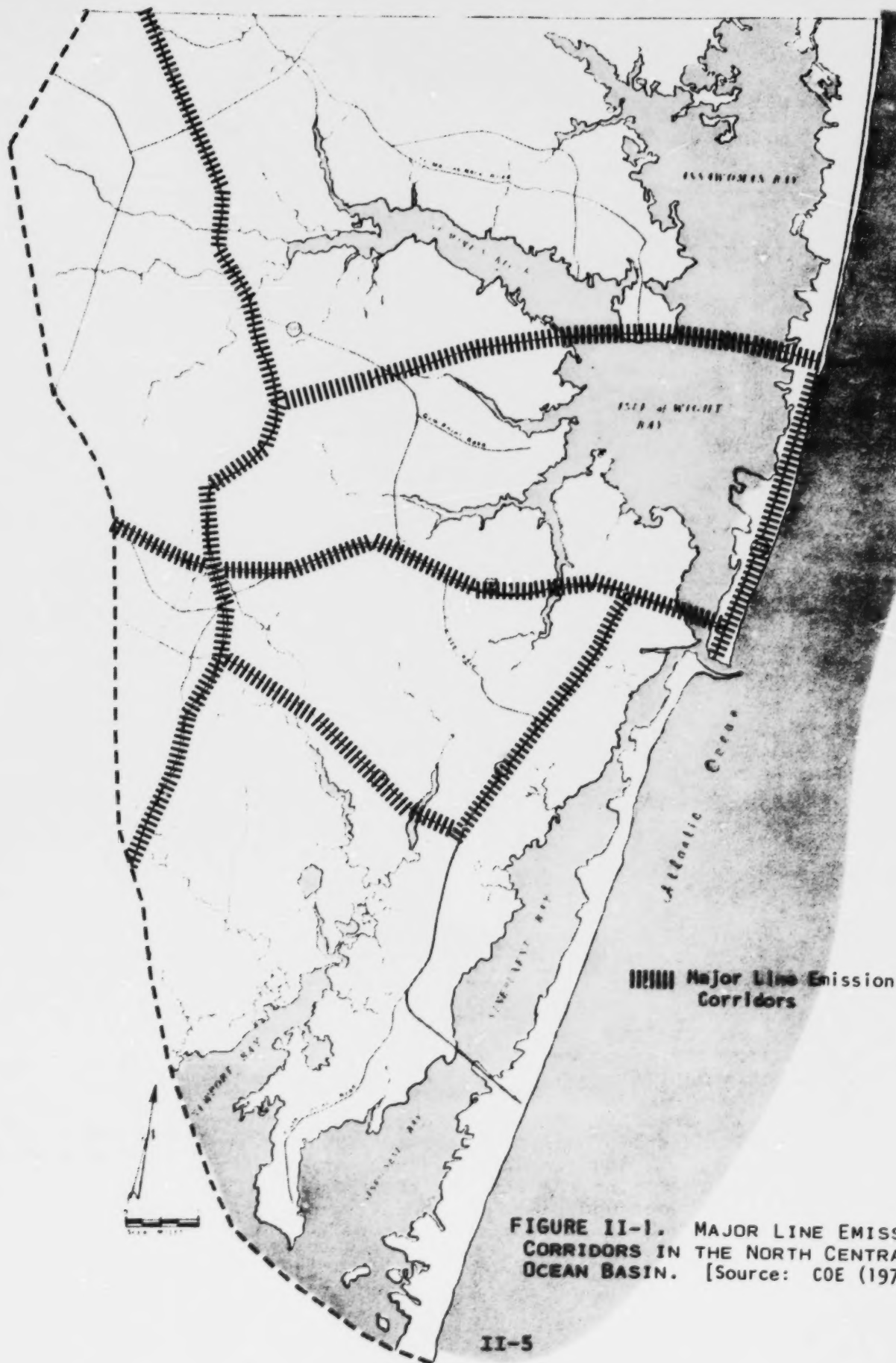


FIGURE II-1. MAJOR LINE EMISSION CORRIDORS IN THE NORTH CENTRAL OCEAN BASIN. [Source: COE (1976)].

Table II-4. Estimated Air Pollutant Emissions (tons/year) in Worcester County in 1975. [Source: BAQNC (1976)].

Source Category	Particulates	SO _x	NO _x	Carbon Monoxide	Hydrocarbons
Electric Utility	5	21	33	1	1
Manufacturing					
Process	62	5	8	--	--
Space Heating	42	286	163	9	5
Comfort Heating					
Residential Heating	29	123	66	63	59
Commercial Heating	0	4	3	--	--
Institutional Heating	2	13	7	--	--
Mobile Sources					
Automobiles	82	20	605	9,625	1,295
Trucks	58	36	1,138	5,065	754
All Other Highway	--	1	5	22	5
Aircraft	--	--	1	178	6
Marine	--	1	1	553	184
Rail	9	20	132	47	34
All Other Mobile	14	10	111	262	137
Refuse Disposal	--	--	--	2	--
Gasoline Storage Handling	--	--	--	--	274
Miscellaneous					
Fires	15	--	2	83	16
Drycleaning Solvents	--	--	--	--	27
TOTAL EMISSIONS	318	540	2,275	15,910	2,797

levels of air quality necessary to protect public welfare (mainly property) from any known or anticipated effects of an air pollutant.

The study area has generally favorable climatic conditions for dispersal of air pollutants. Morning inversions annually average 2,300 feet and lift during the afternoon to 3,900 feet. During the summer, the morning mixing height averages 2,300 feet and rises in the afternoon to 4,600 feet (Holzworth, 1972). Land features also affect mesoscale air

Table II-5. National and State Ambient Air Quality Standards.

	<u>National</u>		<u>State</u>	
	<u>Primary</u>	<u>Secondary</u>	<u>Serious</u>	<u>More Adverse</u>
Sulfur Oxides				
Annual Arithmetic Mean, $\mu\text{g}/\text{m}^3$	80	--	79	60
24-hour Maximum ^b , $\mu\text{g}/\text{m}^3$	365	--	262	--
3-hour Maximum ^b , $\mu\text{g}/\text{m}^3$	--	1,300	--	--
1-hour Maximum ^c , $\mu\text{g}/\text{m}^3$	--	--	920	--
Particulate Matter				
Suspended				
Annual Arithmetic Mean, $\mu\text{g}/\text{m}^3$	75 ^a	60 ^{a,e}	75	65
24-hour Maximum ^b , $\mu\text{g}/\text{m}^3$	260	150	160	140
Settleable				
Annual Arithmetic Average, $\text{mg}/\text{cm}^2/\text{month}$	--	--	0.5	0.35
Monthly Maximum	--	--	1.0	0.7
Carbon Monoxide				
8-hour Maximum ^b , mg/m^3	10		10 ^d	
1-hour Maximum ^b , mg/m^3	40		40	
Hydrocarbons				
3-hour (6-9 AM) Maximum ^b , $\mu\text{g}/\text{m}^3$	160 ^e		160 ^e	
Nitrogen Dioxide				
Annual Arithmetic Mean, $\mu\text{g}/\text{m}^3$	100		100	
Photochemical Oxidants				
1-hour Maximum ^b , $\mu\text{g}/\text{m}^3$	160		160	

a - annual geometric mean.

b - not to be exceeded more than once per year.

c - not to be exceeded more than once per month.

d - applies in areas representing generalized atmospheric levels;
20 ppm applies in any other place where members of the public
congregate for extended periods of time.

e - guideline.

patterns and promote good air quality. The topography is flat, and air masses move freely across the area. The possibility of pollutants being trapped and concentrated in valleys or other restricted areas is minimal. The interface between the land and the sea also promotes mixing and dilution of pollutants by maintaining atmospheric turbulence and motion.

3. Geology and Groundwater

The Coastal Plain of Maryland's Eastern Shore is underlain by a massive wedge of relatively unconsolidated sand and clay with smaller amounts of gravel (Vokes and Edwards, 1968). Beneath Worcester County the thickness of these sediments ranges from one mile to more than a mile and a half. The sediments, which range in age from Triassic to Quaternary, are superimposed upon the eastern extension of the crystalline bedrock of the Piedmont Plateau (Table II-6). The sedimentary rock has been deposited as a series of wedge-shaped sheets with a dip of 10 to 40 feet per mile to the east and southeast.

Fresh groundwater in the study area is restricted to the uppermost 450 feet of coastal plain sediments (Weigle, 1974). Four aquifers occur in these sediments: the Pleistocene, the Pocomoke, the Ocean City, and the Manokin.

- Pleistocene Aquifer. The Pleistocene aquifer provides water for most of the domestic wells in northeastern Worcester County (Weigle, 1974), and is the principal water supply for the Town of Berlin (MSPD, 1969). The aquifer is principally the Beaverdam Sand which occupies the lower one-half to one-third of the Pleistocene deposits. The aquifer's thickness ranges from 25 to 80 feet. The aquifer is recharged predominantly through direct precipitation and percolation of rainfall and snowmelt. Water loss from the aquifer occurs principally through evapotranspiration and discharge to streams and wetlands. The Pleistocene also contributes some water to the underlying Pocomoke aquifer. The Pleistocene aquifer is generally capable of producing moderate to very large supplies of water (500 to 2,000 gpm). Transmissivity of the aquifer ranges from less than 2,500 to more than 10,000 ft²/day (Weigle, 1974). Pleistocene deposits are potentially among the most productive aquifers in Maryland and are capable of extensive development (MSPD, 1969).

Water in the Pleistocene aquifer is generally soft to moderately hard and slightly acidic (median pH 6.85) (Weigle, 1974). Chloride and iron concentrations at

Table II-6. Characteristics of the Geologic Formations beneath the North Central Ocean Basin.
[Source: Weigle (1974)].

System	Series	Group	Geologic Unit	Thickness (ft.)	Hydrologic Unit(s)	Lithologic Character	Water-bearing Characteristics and Hydrology*
Quaternary	Holocene	-	Holocene deposits	0-40 average 5	-	Soil, alluvial sand and silt, dune sand, and peat. Disconformable base.	Commonly unsaturated, but permits water to percolate downward to underlying units. Possibly provides water locally for a few wells near the coast.
			Upper Pleistocene deposits	90-180	-	Lenticular deposits of sand, silt, clay, and peat. Some beds of coarse sand and fine gravel. Tan, some gray, and blue.	Functions as a partial confining bed. Generally capable of yielding supplies of water sufficient for household needs, but water "firm" locally. Susceptible to local salt-water contamination near coast.
			Beaverdam Sand		Pleistocene aquifer	In lower half of Pleistocene deposits. Lenticular or finely stratified deposits of medium-to-very-coarse sand and gravel. Color generally tan, green-brown, white, or gray. Near coast, the bottom 10 or 20 feet is stratified blue clay and gray sand. Aquifer is 20-30 feet thick.	Important aquifer having a potential for large short-term yields. Water "firm" locally. Susceptible locally to salt-water contamination near coast. Water occurs under water-table conditions generally, but is semi-confined or confined in much of the area.
Quaternary (?)	Pleistocene (?)		Pleistocene (?) deposits	0-20			
Tertiary	Miocene	Chesapeake	Yorktown Formation (?)	0-50	Upper confining bed	Lenticular silt, clay, and fine sands. Green-blue silt and fine gray sand most common, but occasionally includes coarse-green pebbly clay.	Confining bed, providing partial hydraulic separation of the Pleistocene and lower aquifers. Pinches out in extreme northwestern part of area, and absent locally elsewhere. Effectiveness as a confining bed is <i>good to poor</i> .
				0-80	Potomac aquifer	Sand, clay or silt, coarse and pebbly generally, but locally fine.	Important aquifer generally 0 to 80 feet thick, but absent under northern Ocean City, where present, generally has a potential for large short-term yields. Potential yields and transmissivity greatest from Newark to Inland-Water Bay, less to northwest, southeast, and northeast. Water confined except in extreme northwestern part of area.
				15-65	Lower confining bed	Blue and gray clayey silt and sand, some peat. Some less of shell and lignite and limestone in top and bottom parts. Middle generally sandy; bottom part sandy in much of area; material in upper part 15-20 feet thick is fine.	Leaky confining layer. In much of the area only the upper part (15-20 feet thick) persists as a confining layer and the middle and lower parts are an aquifer (the Ocean City aquifer).
					Ocean City aquifer	Coarse, gray sand, fine gravel.	Important aquifer at Ocean City; provided the area's public supply in 1970. Hydraulically connected with Manokin.
				140-240	Manokin aquifer	Fine to very coarse gray sand, and some lignite or peat. Some silty sand and clay, especially in middle part of aquifer, toward southeast. Occasional beds of shell and/or "rock".	Very important artesian aquifer. The Ocean City-Manokin aquifer system has a potential for large to very large short-term yields, except in the southwestern part of the area, where the potential is for moderate to large yields. Transmissivities of the Ocean City-Manokin aquifer system increase north-northwestward, and range from about 1,000 to more than 20,000 feet squared per day. At the coast, the Manokin may be susceptible to salt-water invasion in response to large-scale or wide-water withdrawals there.
				160-180	Confining layer	Gray fossiliferous clay, silt, fine sand, and silty and sandy clay.	Confines the base of the Manokin aquifer, preventing or retarding movement of salt water from the Choptank Formation to the Manokin. Probably saturated with, and yields, if salty water, generally not productive of water in this area.
				110-240	Aquifer	Gray fine sand. Thin beds of shell and calcite or limestone.	The aquifer could yield supplies of water at least sufficient for domestic needs, but the water is salty.
					Confining layer	Green or brown clay and fine sand. Thin beds of shell and calcite or limestone.	
			Salvert Formation	450-680	Aquifers and confining layers	Gray sand and diatomaceous silt and clay. Shell beds.	The aquifers could probably yield individual supplies of water measurable in hundreds of gallons per minute, but the water is salty.

* "Moderate" indicates yields of 100-500 gpm; "large", 500-1,000 gpm; "very large", more than 1,000 gpm. Short-term yields are maintainable for several hours at a time with longer intervening periods of no pumping, and assume optimum conditions of well construction and spacing.

at selected wells averaged 19 mg/l (3-66 mg/l) and 4.5 mg/l (0.02-25 mg/l), respectively. Iron concentrations exceeding 0.3 mg/l are "undesirable" (Weigle, 1974). Salt water has penetrated the aquifer in areas near the ocean and tidal marshes. Water at depths greater than 50 feet are generally free of salt.

- Pocomoke Aquifer. The Pocomoke aquifer is composed of gray to tan-gray sand, which is generally coarse and pebbly but may be locally fine. The aquifer occurs at an average depth of 225 feet below sea level and ranges in thickness from 85 to 145 feet (COE, 1976). According to MSPD (1969), yields of high capacity wells range from 100 to 660 gpm, and wells yielding more than 500 gpm are exceptional. Weigle (1974) proposed that the aquifer is generally capable of producing yields ranging from 500 to 2,000 gpm. Transmissivity of the aquifer averages 2,000 to 4,000 ft²/day throughout the study area (Weigle, 1974). Recharge normally occurs by direct percolation from overlying Pleistocene deposits. A portion of the recharge area of this aquifer occurs in the northwest portion of the study area (Figure II-2).

Water in Pocomoke aquifer is normally slightly alkaline (median pH 7.5) and soft to moderately hard (Weigle, 1974). In five selected samples chloride and iron concentrations averaged 15 mg/l (12-20 mg/l) and 3.7 mg/l (0.58-13 mg/l), respectively. Salt water intrusion is not a problem in the aquifer but indirect salt water intrusion could occur at points where the upper confining bed is absent or inefficient or where the overlying Pleistocene aquifer is poorly sealed from adjacent salt water.

- Ocean City - Manokin Aquifer. The Ocean City - Manokin aquifer is separated from the overlying Pocomoke aquifer by the "Lower Confining Bed." The Ocean City and Manokin aquifers are hydraulically connected by leakage through the "semiconfining" basal section of the "Lower Confining Bed." These aquifers are the principal water supplies for Ocean City. The Ocean City aquifer consists principally of gray sand at depths of 240 to 300 feet below sea level beneath Ocean City. The Manokin aquifer consists primarily of fine to very coarse gray sand at depths of 350 to 475 feet below sea level beneath Ocean City. Transmissivities of the Ocean City - Manokin aquifer range from approximately 1,000 ft²/day in the lower Sinepuxent Neck area to 20,000 ft²/day in the vicinity of Berlin, Showell, and Bishopville (Weigle, 1974). The transmissivity of the Manokin aquifer comprises between two-thirds and all of the system's transmissivity. The Manokin aquifer is recharged directly from overlying saturated Pleistocene sands and gravels in western Wicomico and southeastern Dorchester Counties (MSPD, 1969).

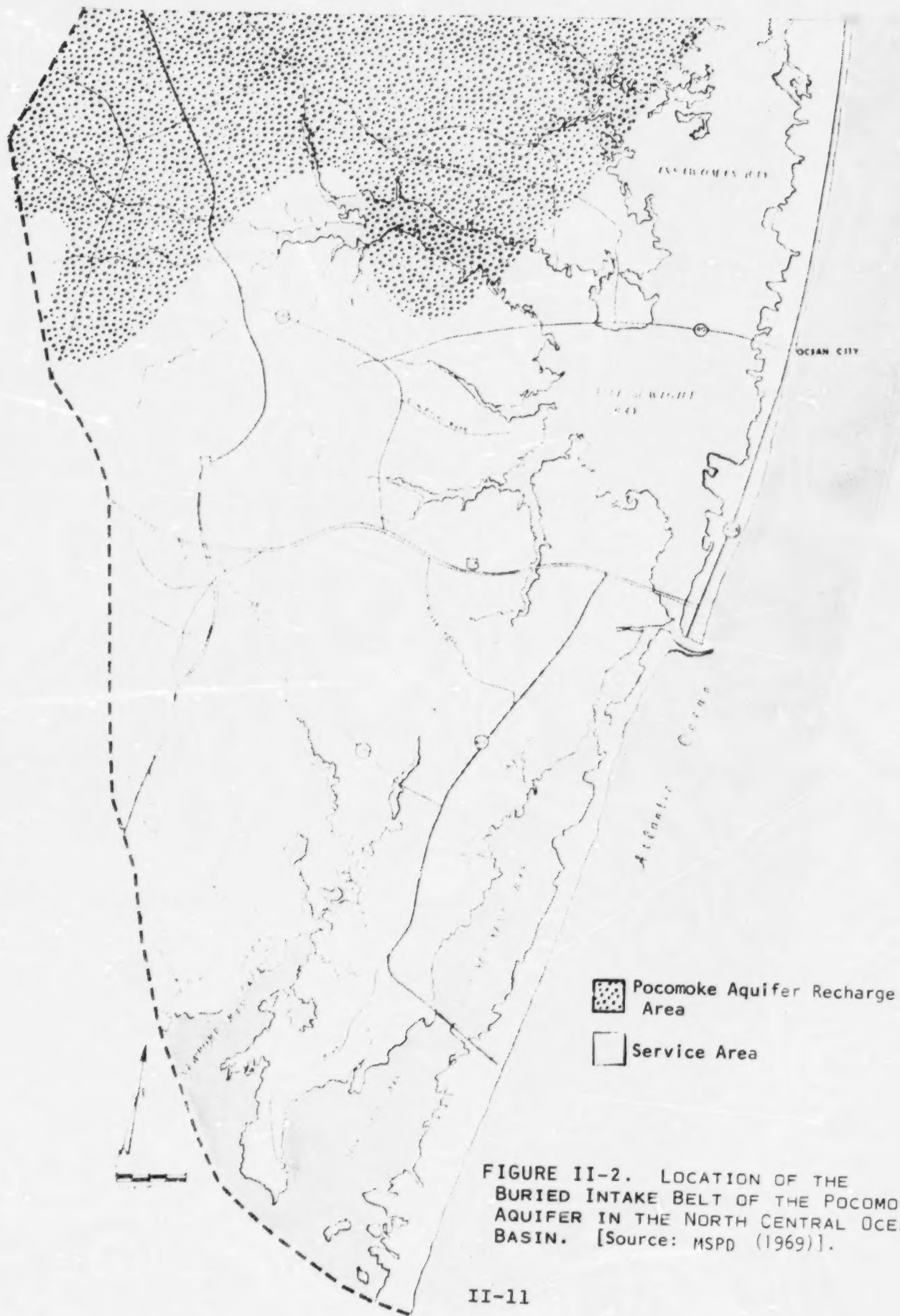


FIGURE II-2. LOCATION OF THE BURIED INTAKE BELT OF THE POCOMOKE AQUIFER IN THE NORTH CENTRAL OCEAN BASIN. [Source: MSPD (1969)].

Water in the Ocean City-Manokin aquifer is slightly alkaline (median pH 8.5) and moderately hard to hard (Weigle, 1974). Chloride and iron concentrations at selected wells averaged 33 mg/l (7.5-59 mg/l) and 4.1 mg/l (0.02-13 mg/l), respectively. The lower limit of fresh water in the aquifers beneath Ocean City is approximately the contact between the Manokin aquifer and the St. Mary's Formation. Salt water intrusion is restricted to the basal section of the Manokin aquifer. Weigle (1974) proposed that the danger of salt water intrusion into the Manokin aquifer will increase with increased withdrawals. No evidence of increasing salt water intrusion was present during his recent survey of the area.

4. Topography and Soils

The topography of the North Central Ocean Basin is generally flat or gently undulating. The Basin is bordered on the west by the Berlin scarp (Weigle, 1974). The face of the scarp slopes gently eastward descending from elevations 35 to 40 feet to 10 to 15 feet above sea level. Physiographic divisions include uplands, marshes, and barrier islands. Sinepuxent, Isle of Wight, and Assawoman Bays separate the mainland from Fenwick and Assateague Islands. Tidal marshes border the eastern and western shores of the bays.

Surface water drainage from the study area occurs through 22 drainage basins identified by GMB (1976). Surface water from the mainland drains into the coastal bays. Streams draining the area are generally at their base levels and flows are often sluggish.

As part of the capability analysis for the Maryland Land Use Plan, MDSP (1973) reviewed all of the SCS soil surveys from the counties in the state and assembled the soils into groups having similar properties. These assemblies were defined as "Natural Soil Groups". The six major properties used for the grouping included agricultural productivity, erosion susceptibility, permeability, depth to bedrock, depth to water table, and stability. The Natural Soil Groups have been arranged in order of increasing limitations or problems for most uses, with Group A1 being the least limited and Group H2 being the most limited. Subgroups (such as Ala) are divided only

on the basis of slope steepness where this becomes a factor affecting use.

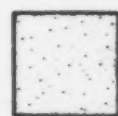
Ten Natural Soil Groups occur within the North Central Ocean Basin. In addition, one group (Ma) is a direct result of human activity (Figure II-3). The physical and chemical properties of the Natural Soils Groups are summarized in Table II-7.

Group A1 consists of deep, very sandy, somewhat excessively to excessively drained soils. The landform is normally level to undulating. The soils are strongly to extremely acid, very rapidly permeable, and have a low to very low available moisture capacity. The soils are extremely susceptible to wind erosion when they are dry and without vegetative cover. Applied lime and fertilizer leach rapidly from these soils. This group occupies approximately 1.2 percent of the study area.

Group A consists of land types which have minimal soil development. These soils are sands which are constantly reworked by the action of waves, winds, and tides. The pH of this group is extremely variable and may be very strongly acid or strongly alkaline. These sands are rapidly permeable and have a very low moisture capacity. This group generally occurs along the beaches of the Atlantic Ocean, and occupies 3.0 percent of the study area.

Group B1 soils are deep, well drained, and permeable. They generally have a high or moderate available moisture capacity. Depth to bedrock is generally greater than five feet, and the soils normally contain few rock fragments. These soils are neutral to extremely acid but respond well to the addition of fertilizers and lime. Group B1 soils are prime agricultural soils where the only limitation is the steepness of slope. This group occupies approximately 17.8 percent of the study area.

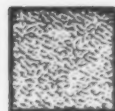
Group E1 soils are level to moderately sloping and are moderately well drained. Their substrate is loose sand. The soils are naturally acidic. During the late winter and early spring, the fluctuating water table may rise to within 1.5 feet of the surface. During the summer, the water table may fall to 4 to 6 feet. The soils have a moderate to high available moisture capacity in the absence of the water table.



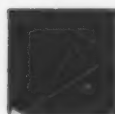
G3



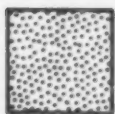
G2



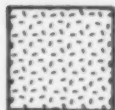
E1



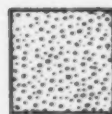
E3a



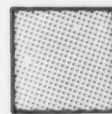
B1a



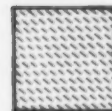
A1a



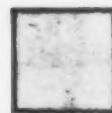
F1



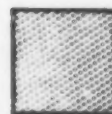
F3



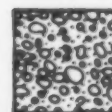
Ma



F2



A2



Extractive

LEGEND FOR FIGURE II-3
NATURAL SOIL GROUPS

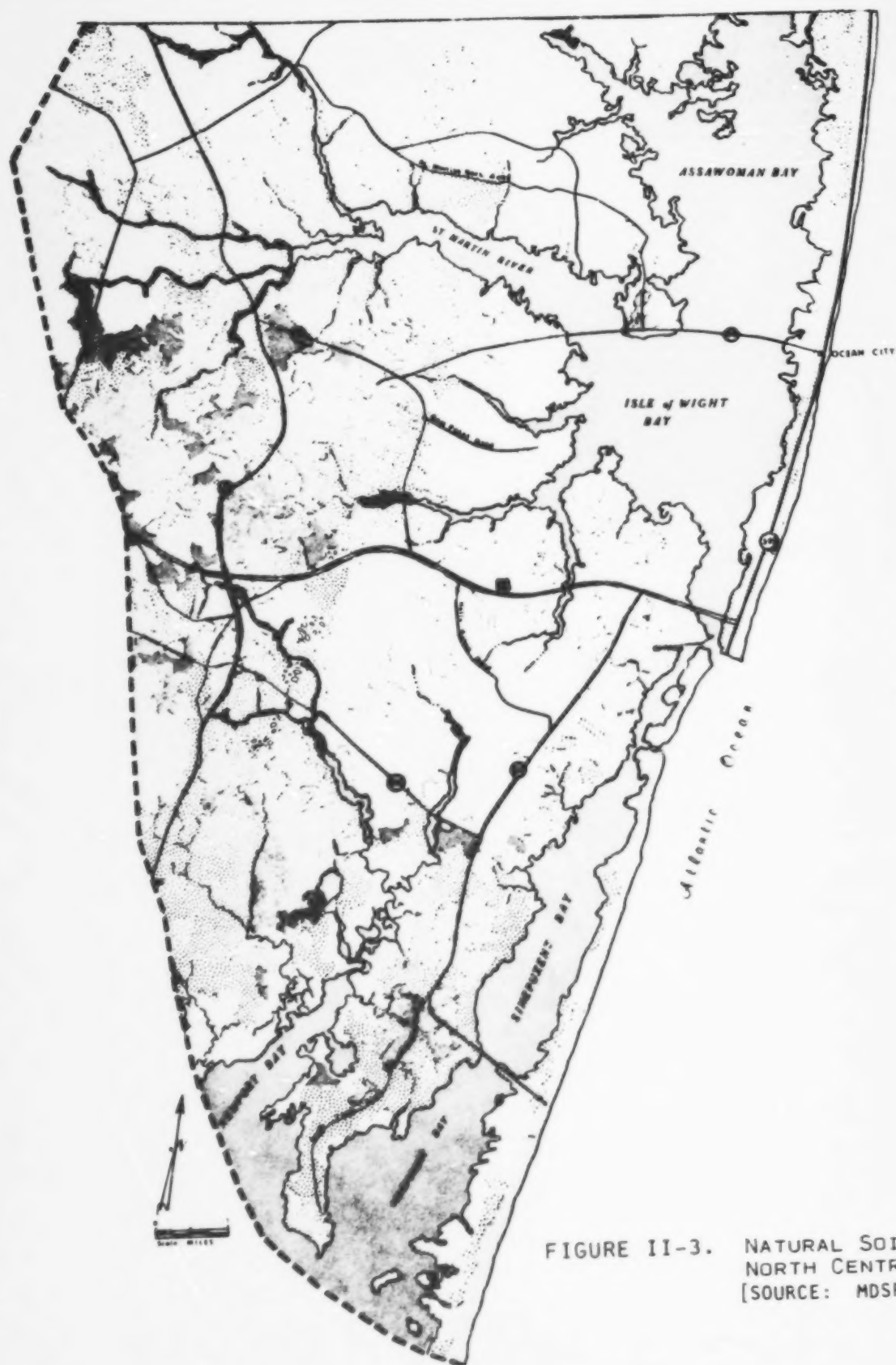


FIGURE II-3. NATURAL SOIL GROUPS OF THE NORTH CENTRAL OCEAN BASIN. [SOURCE: MDSP (1973)].

II-16

Table II-7. Characteristics of the Natural Soil Groups Occurring in the North Central Ocean Basin.
[Source: MDSP (1973)].

Natural Soil Group	Depth to		Dominant USDA Textures	Erodibility (K factor)	Runoff Potential (Hydro-logic Group)	Permeability (in/hr)	Percolation (min/in)	Available Water Capacity (in/in of soil)	Shrink/Swell Potential	Frost-Action Potential
	Bedrock (inches)	Seasonal High Water Table (feet)								
A1	72+	4+	Loamy sand, sand or sandy loam	Very low (.17)	Low (A)	>60	Faster than 45	.02-.06	Low	Low
A2	72+	1.10	Sand	Very low (.17)	Low (A)	>6.0	Faster than 45	<0.06	Low	Low
B1	72+	3+	Silt loam, loam, fine sandy loam, sandy loam, silty clay loam, clay loam, silty clay, clay	Moderate (.32)	Moderately low (B)	0.60-2.0	45-60	.12-.24	Low to Moderate	Moderate
E1	72+	1.5-2.5	Sandy loam, sandy clay loam, loamy sand, sand	Low (.28)	Moderately high (C)	0.60-6.0	Faster than 60	.12-.24	Low	High
E3	72+	1.2-2.5	Silt loam, loam, silty clay loam	High (.37)	Moderately high (C)	0.20-0.60	Slower than 30	.18-.24	Low to Moderate	High
F1	72+	0-1	Loamy sand, sand	N/A	High (D)	>6.0	Faster than 45	<0.06	Low	High
F2	72+	0-1	Sandy loam, fine sandy loam, sandy clay loam, loam, loamy sand	Low (.28)	High (D)	0.60-2.0	Faster than 60	.12-.24	Low	High
F3	72+	0-1	Silty clay loam, clay loam, silty clay, clay, loam, silt loam	Very high (.43)	High (D)	<0.60	Slower than 60	.18-.24	Moderate to High	High
G2	72+	0-1	Silt loam, silty clay loam, silty clay, fine sandy loam, sandy loam, loam, muck	N/A	High (D)	0.60-6.0	Faster than 45 to Slower than 60	.18-.24	Low to High	High
G3	72+	0	Variable	N/A	N/A	Variable	Variable	Variable	Low to High	Variable

Group E1 occupies approximately 7.8 percent of the study area.

Group E3 soils are deep, moderately well drained, and silty. The soils are moderately permeable and have a high available moisture capacity. The water table rises to within 1.5 to 2.5 feet of the surface during the winter and late spring. The soils are highly susceptible to frost-action and to erosion by water on slopes. Group E3 occupies approximately 3.8 percent of the study area.

Group F1 soils are the wettest sandy soils in Maryland. Drainage is poor, and the water table is at or near the surface throughout most of the year. The soils normally occupy level or depressional areas. Permeability is rapid in the absence of a high water table. The soils are strongly to extremely acidic and are very low in natural fertility. Farm and nonfarm uses of these soils are extremely limited. Group F1 occupies approximately 2.0 percent of the study area.

Group F2 soils are normally poorly to very poorly drained and contain enough clay and silt to maintain moderate to high available moisture for plants through dry periods. The soils are strongly to extremely acidic and are moderately permeable in the absence of a water table. The water table is severely limiting. It reaches the surface during December or January and remains until late April or early May. The soils are easily drained, and drainage is required for most farm and nonfarm uses. Group F2 occupies approximately 40.9 percent of the study area.

Group F3 soils are poorly drained and occupy gently sloping to depressional areas. The dense subsoils limit permeability and make drainage difficult. The soils have a high shrink-swell potential, a high potential for frost action, high compressibility, poor compaction, and poor stability. Many of the soils are clayey, sticky and plastic when wet, and become hard and intractable when dry. Group F3 occupies approximately 7.4 percent of the study area.

Group G2 soils are deep, poorly drained, and occupy floodplains along rivers and streams. These soils are subject to frequent flooding and have slow to

moderate permeability. The water table is at or near the surface during the winter and spring and recedes to less than three feet in drier seasons. These soils are moderately to severely limited for farming. Group G2 occupies approximately 1.1 percent of the study area.

Group G3 soils consists of Tidal Marshes and Swamps. The soils have standing water on them for most of the year and are valuable mostly as wildlife habitat. These soils occupy 12.4 percent of the study area.

Group Ma is "made" land which is soil that has been used to fill marshes and other low lying areas for urban use. Approximately 2.5 percent of the land in the study area is "made" land.

5. Hydrology and Water Quality

The principal surface water resources of the North Central Ocean Basin are the near-shore Ocean and the coastal bays: Assawoman, Isle of Wight, and Newport and Sinepuxent.

Precipitation on the Delmarva Peninsula is the principal source of freshwater in the North Central Ocean Basin. Precipitation falling directly on the Basin is dissipated as evapotranspiration, overland flow, and infiltration into the ground (Cushing et al., 1973). COE (1976) proposed that approximately 61 percent of the total annual precipitation on the area is returned to the atmosphere through evapotranspiration. Approximately 10 percent of the precipitation enters streams as overland runoff, and 29 percent infiltrates the soil surface to the water table. As much as 83 percent of the water infiltrating the soil is discharged to surface streams and maintains base flows during dry weather. The remaining 17 percent is stored in the groundwater. The average annual precipitation on the Basin is 47 inches. Cushing et al., (1973) determined that runoff from the adjoining Upper Pocomoke River Basin is equivalent to 14.7 inches (31 percent) of annual precipitation. Average flow from that basin is generated at an average rate of 1.08 cubic feet per second per square mile (cfs/mi). Assuming that the North Central Ocean Basin is hydrologically similar to the Upper Pocomoke River Basin, average freshwater discharge from the study area into the coastal bays is 109 cfs (70.4 mgd) and is partitioned at 7.9 mgd to Assawoman Bay, 37.4 mgd to Isle of Wight Bay, and 25.1 mgd to Newport and Sinepuxent Bays.

Freshwater runoff from the study area is seasonal. Approximately 66 percent of the total annual runoff occurs between the months of December and May. Although this is

normally a period of low precipitation, surface runoff is promoted by high groundwater levels and minimal evapotranspiration. During the period from May through September, approximately 25 percent of the total annual freshwater runoff from the Basin enters the coastal bays.

The coastal bays in the study area are typical mid-Atlantic, bar-built estuaries. Circulation and flushing in the bays are restricted by low freshwater inflow and by limited exchange with the Atlantic Ocean through the Ocean City Inlet, with Little Assawoman Bay in Delaware through the "Ditch", and with Chicoteague Bay. Tides are the dominant mixing and flushing forces in the bays. However, because of their shallow depths and large surface areas, the bays are subjected to wind-driven circulation and mixing. During these periods turbidity is substantially increased through resuspension of bottom sediments. Based upon its analysis of the coastal bays, WRA (1976) formulated a discharge policy which considers the allocable waste assimilation capacity of the bays to be minimal, and which permits no new direct surface discharges of treated wastewater and no increases in wasteloads beyond existing discharge permits.

Assawoman Bay is the northernmost of the coastal bays. The bay has a surface area of 8.5 square miles. The average depth is 3.5 feet with deeper water in the channels (8 feet) and in the "Ditch" (15 feet). Tidal currents in the center of the bay are from the north at an average velocity of 0.18 knots (0.3 ft/sec) (COE, 1975a). In the "Ditch" tidal current velocities range from 0.51 to 0.76 knots (0.86 to 1.3 ft/sec). The average tidal amplitude in the bay is 1.0 to 1.5 feet (COE, 1975a). Tidal amplitudes in the "Ditch" range from two to three feet.

Assawoman Bay has been classified as a shellfish harvesting (Class II) segment. WRA (1976) stated that its survey of the bay had revealed no violations of water quality standards. Nutrient concentrations were generally low (Table II-8). Inorganic nitrogen concentrations ranged from 0.03 to 0.09 mg/l as N, and total phosphorus concentrations ranged from 0.03 to 0.59 mg/l as P. Chlorophyll a concentrations averaged 29 mg/l and ranged from 0.3 to 200 µg/l. WRA (1976) proposed that the bay "is showing some signs of enrichment or eutrophication."

II-20

Table II-8. Water Quality of the Coastal Bays (1974-1975). [Source: Maryland Water Resources Administration].

Water Quality	Average ¹	Range	Average	Range	Average	Range	Average	Range	Average	Range
Dissolved Oxygen (mg/l)	8.3	4.3-17.0	8.2	3.7-17.6	8.6	1.3-17.6	7.3	3.9-10.0	7.4	4.3-11.2
Fecal Coliform (MPN/100 ml)	21	3-640	41	3-930	432	3-7,500	5	3-21	9	3-93
Chlorophyll <i>a</i> (µg/l)	29	.3-200	29	3-210	48	1-213	33	6-81	26	1-150
Inorganic Nitrogen (mg/l)	.08	.03-.99	.11	.03-1.16	.63	.03-18.3	.05	.02-.14	.07	.02-1.69
Total Phosphorus (mg/l)	.12	.03-.59	.13	.03-.80	.26	.01-4.74	.15	.05-.44	.11	.01-.44
Water Temperature (°C)	19.1	1.7-28.3	18.6	2.0-39.0	19.7	0.2-30.0	20.6	10.0-30.0	21.3	2.0-30.0
Salinity (‰)	23.8	0.2-43.0	25.7	2.0-47.4	18.2	0.0-42.4	21.6	2.4-33.1	26.9	2.4-46.1
Turbidity (JTU)	9.2	2.0-200.	9.8	2.0-28.0	9.7	2.0-42.0	13.4	3.0-27.0	12.0	2.0-54.0
Number of Stations		10		11		13		2		6

¹ Arithmetic mean of 1975-1976 station means (all observations).

Note: Number and Seasonal Distribution of Samples varies among Stations. Generally more samples taken in summer months.

Isle of Wight Bay has a surface area of approximately 7 square miles and an average depth of four feet (COE, 1975a). In the lower portion of the bay, tidal amplitudes range from three to four feet and maximum tidal currents are approximately 3.4 knots (5.7 ft/sec). In the upper bay, tidal amplitudes decrease, and average tidal current velocities are 0.15 knots (0.25 ft/sec). WRA (1976) reported that water tracer dye, introduced into Isle of Wight Bay by personnel of the Chesapeake Bay Institute (CBI), was not significantly dispersed by tidal currents and remained concentrated along the eastern shoreline of the bay. A significant quantity of dye flowed out of the Isle of Wight-Assawoman Bays through the "Ditch".

Isle of Wight Bay has been classified as a shellfish harvesting (Class II) segment. Its tributaries, such as Bishopville Prong and Herring Creek are Class I waters. The Isle of Wight Bay segment is the most severely degraded area in the North Central Ocean Basin (WRA, 1976). As a result of this degradation shellfish harvesting has been prohibited in Turville Creek, Herring Creek, and the St. Martin River. In Isle of Wight Bay, inorganic nitrogen concentrations range from 0.03 to 1.16 mg/l as N, and total phosphorus concentrations range from 0.03 to 0.80 mg/l as P. Chlorophyll a concentrations average 29 ug/l and range from 3 to 210 ug/l. Fecal coliform concentrations range from 3 to 930 MPN/100 ml. In the St. Martin River, chlorophyll a concentrations range from 1 to 213 ug/l and average 48 ug/l. Fecal coliform concentrations range from 3 to 7,500 MPN/100 ml and average 432 MPN/100 ml. Dissolved oxygen concentrations range from 1.3 to 17.6 mg/l, and average nutrient concentrations are between two and six times higher than those in Isle of Wight Bay. Water quality in other tributaries of Isle of Wight Bay is discussed in the Ocean Coastal Basin: Water Quality Management Plan (WRA, 1976).

Sinepuxent Bay has a surface area of approximately 9 square miles and an average depth of 2.2 feet (COE, 1975a). Depths approach six feet in the main channel and 15 to 25 near the Ocean City Inlet. Tidal amplitude in the bay decreases from 3.4 feet near the inlet to 0.4 feet near the southern end of the bay. A water-tracer dye study of the bay reported by WRA (1976) revealed a net advective transport of dye to the north at an average rate of 1.2 miles per day (0.7 ft/sec).

WRA (1976) reported that water quality in Sinepuxent Bay is generally good. The bay has been classified as a shellfish harvesting (Class I) segment except Ocean City Harbor which is Class I. No violations of dissolved oxygen or bacteriological standards have been observed by WRA. Inorganic nitrogen concentrations ranged from 0.02 to 1.69 mg/l as N, and total phosphorus concentrations ranged from 0.01 to 0.44 mg/l as P. Chlorophyll a concentrations averaged 26 ug/l and ranged from 1 to 150 ug/l. Water quality problems in this segment are generally restricted to the West Ocean City Harbor and Snug Harbor.

Newport Bay has a surface area of approximately 4.1 square miles and an average depth of four feet. The bay has been classified as a shellfish harvesting (Class II) segment. Trappe Creek is the principal tributary of the bay. The Newport Bay basin is a significant contributor of wastewater to Chincoteague Bay (WRA, 1976). WRA (1976) proposed that approximately two mgd of wastewater are discharged into the tributaries of Trappe Creek and Newport Bay.

Water quality data from Newport Bay indicate that the system is significantly enriched from runoff and wastewater discharges originating in its drainage basin (Table II-8). Inorganic nitrogen concentrations ranged from 0.02 to 0.14 mg/l as N, and total phosphorus concentrations ranged from 0.05 to 0.44 mg/l as P. Chlorophyll a concentrations averaged 33 ug/l and ranged from 6 to 81 ug/l. Fecal coliform concentrations ranged from 3 to 21 MPN/100 ml and averaged 5 MPN/100 ml. WRA (1976) reported that dissolved oxygen concentrations in Trappe Creek were "marginal" and that bacterial standards have been exceeded in Trappe and Ayer Creeks.

WRA (1976) noted that nonpoint source pollution may be more important in determining water quality in the coastal bays than point source discharges. Nonpoint sources mentioned by WRA included stormwater runoff from Ocean City into Assawoman and Isle of Wight Bays and agricultural runoff into all of the bays. EPA has prepared a preliminary nonpoint source sediment and nutrient budget for the North Central Ocean Basin (Table II-9).

The budget was prepared from the land use map (Figure II-11) prepared by MDSP and nonpoint-source, pollutant-generation coefficients (Uttormark, Chapin, and Green, 1974; WRA, 1976). Sufficient nonpoint source loading data are not available to verify the loading coefficients. However, the loading coefficients used in the budget have been verified for similar land uses in the Upper Pocomoke River Basin (EcolSciences, 1976). As predicted by WRA (1976) the budget indicates that agricultural and urban areas are the principal sources of nonpoint source pollutants in the North Central Ocean Basin.

Table II-9. Annual Nonpoint Source Loads (in Tons) of Sediment and Nutrients to the Coastal Bays from the North Central Ocean Basin. The Figure in Parentheses is the Average Daily Loading Rate in lbs/day.

	Assawoman Bay	Isle of Wight Bay	Newport and Sinepuxent Bays
Suspended Sediment	11,300 (61,900)	97,400 (534,000)	52,700 (289,000)
Nitrate and Ammonia	10 (53)	83 (456)	47 (259)
Total Nitrogen	15 (80)	95 (522)	55 (302)
Inorganic Phosphorus	2 (9)	6 (32)	4 (21)
Total Phosphorus	3 (17)	11 (62)	8 (43)

The Atlantic Ocean assaults approximately 19 miles of high-energy beach bordering the North Central Ocean Basin. Waves measured in the ocean offshore from Delaware Bay average 4 feet in height from October through March and 3 feet in height during the remainder of the year (Polis & Kupferman, 1973). The larger waves normally occur during the months of northerly or northwesterly winds of 15 mph or greater. The smaller waves occur during the months of southerly winds with speeds of less than 15 mph. Mean swell direction offshore from Delaware Bay is from the southeast during the summer and from the northeast during the winter (Maurer and Wang, 1973). The predominant wave height measured at Ocean City from 1955-1957 ranged from 2.0 to 4.3 feet, and the waves moved from

the southeast 41 percent of the time (Pellenbarg and Biggs, 1970) (Table II-10). Net littoral drift along the beach south of Bethany Beach, Delaware is southward toward Ocean City (COE, 1975b).

Table II-10. Mean Surf Characteristics at Ocean City, Maryland, from 1955 through 1957. [Source: Pellenbarg and Biggs (1970)].

Year	Mean Surf Height in Feet				Wave Direction in Percent Time			
	0-2.0	2.0-4.3	4.3-6.2	6.2-9.8	NE	E	SE	S
1955	22%	68%	6%	3%	24	16	47	13
1956	18%	72%	8%	3%	34	16	31	19
1967	10%	81%	9%	1%	21	30	45	4
3-Year Mean	16%	74%	8%	2%	26	21	41	12

GMB (1976) designed the proposed outfalls to withstand the wave and surge characteristics in Table II-11.

Table II-11. Wave and Surge Characteristics Incorporated into the Design of the Proposed Assateague Island Outfall. [Source: GMB (1976)].

	Hurricane	Winter Storm
Significant Wave Height (feet)	15-20	15-20
Maximum Wave Height (feet)	15-30	25-30
Significant Period (seconds)	10-12	10-14
Storm Surge (feet)	4-6	4-5

Carter (1966) determined that the current along the

Ocean City beach is predominantly tidal and attains its maximum speed of 0.4 to 0.6 knots (0.7 to 1.0 ft/sec) at high and low water. The longshore current is zero in the surf zone and increases out to 400 yards from shore. The current is relatively constant from 400 to 2,000 yards from shore. An on-shore current has a maximum velocity of 5 cm/sec (0.16 ft/sec) between 400 and 2,000 yards from shore. The velocity of this current is zero near the surf zone. Water tracer dye released near the site of the existing sewage outfall flowed north during the flood tide, rotated to the east during the change from flood to ebb, flowed south during the ebb tide, and rotated to the west during the change from ebb to flood. Dye spread along the beach during the change from ebb to flood. Carter further determined that southerly winds which persisted for 4 to 5 days could produce an unstable horizontal density distribution which would allow a mass displacement of surface water shoreward toward the beach. Minimum effluent dilutions from the existing diffuser ranged from 67:1 to 82:1 and occurred at slack water (Carter, 1976). The average dilution over the length of the diffuser was 158:1. Carter (1976) proposed that additional flows could be accommodated by the diffuser without significant loss of dilution, if these flows are discharged uniformly throughout the day.

Carter (1976) examined oceanic water quality in the vicinity of the Ocean City outfall in November, 1974 and July, 1975. Water quality was monitored along three transects perpendicular to the shore at three stations per transect and at three depths per station. The northern and southern transects were approximately 9,120 and 7,296 feet from the outfall, respectively. The third transect was immediately above the outfall. From a cursory review of the data (Table II-12), Carter (1966) concluded that, "Most measurements clearly fell within a range typical of coastal waters."

The distribution of dissolved oxygen with depth and with distance from shore was generally uniform during November, but some oxygen stratification with depth was observed during July. Only two (2) concentrations less than 4 mg/l (2.8 ml/l) were observed, one each from the bottom waters north and south of diffuser at the most distant points offshore. Some seasonal and spatial differences in the distribution of the inorganic nitrogen were observed, but total inorganic nitrogen concentrations generally increased with depth, and were greater to the south of the outfall, and were higher in the summer than in the winter. Mean concentrations of total phosphorus and ortho-phosphate were similar in the transects north and south of the outfall. Mean total phosphorus concentrations were

Table II-12. Water Quality of the Atlantic Ocean in the Immediate Vicinity of the Ocean City Outfall. [Source: Carter (1976)].

<u>Parameter</u>	<u>Mean</u>	<u>Range</u>	<u>Number of Observations</u>
Salinity (‰)	30.2	28.3 - 31.5	36
Dissolved Oxygen (ml/l)	4.61	2.21 - 6.42	36
Water Temperature (°C)	16.9	5.11 - 23.2	36
Ortho-Phosphate (µg-at/l)	0.6	0.2 - 1.2	36
Total Phosphorus (µg-at/l)	1.4	0.4 - 5.5	36
Ammonia (µg-at/l)	1.55	0.17 - 4.31	36
Nitrite & Nitrate (µg-at/l)	1.69	0.40 - 8.0	36
Total Inorganic Nitrogen (µg-at/l)	3.24	0.89 - 10.0	36
Coliform Bacteria			
Total (MPN/100 ml)	3	<3 - 460	30*
Fecal (MPN/100 ml)	<3	<3 - 43	
Cadmium (ppm)	1.0	0.2 - 1.7	5
Cobalt (ppm)	6.0	2.9 - 9.3	5
Chromium (ppm)	30.0	21.0 - 40.0	5
Copper (ppm)	19.0	10.0 - 28.0	5
Iron (ppm x 10 ³)	0.017	0.035 - 0.031	5
Manganese (ppm)	339.0	106.0 - 581.0	5
Nickel (ppm)	14.0	7.0 - 23.0	5
Lead (ppm)	35.0	20.0 - 54.0	5
Zinc (ppm)	118.0	40.0 - 200.0	5

* Includes samples above the diffuser.

similar in November and July, whereas ortho-phosphate concentrations were higher in November than in July. There was generally minimal variation with depth except over the diffuser. Fecal coliform levels were less than 3/100 ml in 28 of the 30 water samples analyzed from all stations in July, 1975. The two samples having concentrations greater than 3/100 ml (9 and 43/100 ml) were collected from the immediate vicinity of the outfall. Four other samples had total coliform concentrations greater than 3/100 ml but contained no detectable fecal coliforms.

The Maryland Department of Health and Mental Hygiene (DHMH) established a buffer zone around the Ocean City outfall in which the harvesting and holding of shellfish is prohibited effective January 29, 1973. This buffer zone includes all the waters of the Atlantic Ocean from 55th Street to 73rd Street extending 1.5 miles out to sea. DHMH also established a bacteria monitoring program which covers the entire length of Maryland's ocean waters. Total and fecal coliform concentrations observed during the program have generally been less than 3/100 ml at all stations. Concentrations greater than 10/100 ml are seldom recorded. The ocean stations are not sampled as frequently as the inland bays, because the coliform concentrations have not been observed to vary significantly (D. Elmore, DHMH, 1977, Personal Communication).

6. Biology

The North Central Ocean Basin and adjacent estuarine and coastal waters contain a multitude of plant and animal species which are components of an intricate biological system. Sections a and b contain brief descriptions of the major components of that system. Endangered species known to occur in the planning area are discussed in Section c and Potential Natural Areas in Section d. Section e contains the results of field studies performed in all areas which would be impacted during construction of the applicant's selected plan.

a. Terrestrial Communities

The principal terrestrial communities of the study area are separated in the following discussions according to their presence on the barrier dune systems, wetlands, or forested areas.

1) Barrier Dune Communities

Two barrier dune systems protect the mainland of Worcester County from most oceanic processes. Fenwick Island extends from the Maryland-Delaware boundary to the Ocean City Inlet, and Assateague Island extends south of the inlet beyond the Maryland-Virginia boundary.

Barrier dune systems (barrier islands, reefs, etc.) are continuously subjected to atmospheric and oceanic induced stresses (wind, wave, tide, etc.) of varying intensities which constantly alter their locations, sizes, and physiographies. Paradoxically, this dynamic state maximizes the lifespan of these systems (LaRoe, 1976). Past artificial modifications of vital processes or components have resulted in degradation of the systems. Dolan et al. (1973) demonstrated that substantial amounts of sand are lost from barrier dunes upon stabilization of the foredune. According to the U. S. Army Corps of Engineers (1975), "the shoreline of Ocean City has receded except for the area between 10th Street and the inlet where construction of the north jetty in 1934 impounded littoral material causing an oceanward advance of the shoreline in this reach. The beach immediately adjacent to the north jetty has a width of about 800 ft. The shoreline north of 10th Street to the Delaware-Maryland line has eroded at an average rate of six feet/year. . . surveys of Assateague Island, Maryland, covering the same period indicate a general trend of erosion along the Maryland portion of Assateague Island averaging three feet/year. The jetties protecting the inlet have interrupted the southerly movement of littoral (intertidal) material, resulting in increased erosion of the northern portion of the island. The rate of erosion of the northern five-mile reach of the island is estimated at 35 feet annually. South of this reach, Assateague Island has eroded at a fairly uniform rate of about one-half foot annually."

Barrier dune systems naturally migrate inland during periods of rising sea level (Johnson, 1919). The process is gradual and results from the loosening of foredune soils through plant removal, transportation inland by wind, and eventual aggradation along bay shores. Artificial disturbances, such as those cited above, increase the rate of movement inland. The increased rate of movement is directly proportional to the amount of disturbance.

For discussion purposes, the barrier dune system is divided into high energy beaches and dunes.

a) High-Energy Beaches

The high-energy beach is defined as the zone of unconsolidated material occurring between the foredune and the mean low water level (Davis, 1972). The beach is commonly divided into backshore and foreshore. The backshore zone, extending from the foredune to spring high water, is inundated only by storm tides. The foreshore zone occurs within the intertidal zone and is subjected to diurnal inundation.

The beach profile changes seasonally as a result of storm-induced wave dynamics. During the winter, high-energy, local storm waves, having short wavelengths and steep slopes, are capable of suspending backshore sediments for periods sufficient to allow seaward transport by rip currents (Anikouchine and Sternberg, 1973). These sediments, are returned to shore during summer by the lower energy, longer wavelength, and less steep waves produced by storms which are more distant during that season.

Higher plants are scarce on the backshore and absent on the foreshore. Higgins et al., (1971) stated that the plant cover of the backshore of Assateague Island did not exceed one percent. Sea rocket (Cakile edentula) was most frequent. Saltwort (Salsoli kali), coast amaranth (Amaranthus pumilus), and seabeach sandwort (Arenaria peploides) were rare. (Nomenclature is according to Fernald (1950), plant scientific names and their respective common names are provided in Appendix A). Attached macrophytic algae are absent on both the backshore and foreshore.

The high-energy beach system offers space for three main faunal assemblages: epipsammon, endopsammon, and mesopsammon (Riedl and McMahan, 1973). Epipsammon occur on or above the substrate and include the sanderling (*Crocethia alba*), fish, and insects, particularly beetles.

The endopsammon is comprised of species which occur below the beach surface but in areas larger than interstitial spaces. Representative groups are polychaetes, amphipods, isopods, stomatopods, many decapods, gastropods, bivalves, and echinoderms (Riedl and McMahan, 1973).

The mesopsammon occurs in interstitial spaces and is the most diverse faunal assemblage. It contains more than 1,000 species (Riedl & McMahan, 1973). Dominant groups are diatoms, ciliates, turbellarians, gnathostomalids, gastrotichs, nematodes, and harpacticids (copepods). Only a few groups have not adapted to this environment.

Productivity within the high-energy beach system is not sufficient to satisfy consumption. Energy is transferred from outside sources through species which feed in open water and deposit feces in or on the sediment such as mole shrimp, polychaetes and lancelets.

b) Dunes

Approximately ten linear miles of Assateague Island are included within the study area. Higgins et al., (1971) collected 441 plant species, representing 88 families, during a comprehensive floristics and vegetative study of the island and presented an annotated species list in The Flora and Ecology of Assateague Island. The authors divided the vegetation into four zones: dune herbaceous, shrub, arborescent, and marsh herbaceous. A detailed description of each zone is presented in the previously mentioned publication.

Fenwick Island is approximately nine miles long and probably resembled Assateague Island before the development of Ocean City, Ocean

Bay City, Fenwick, and Maryland Beach. The structure and areal extent of original communities have been drastically reduced by that development.

Comprehensive lists of all birds, mammals and herpetofauna expected to occur on the barrier dune systems are presented in Tables A-1 through A-4 in Appendix A.

2) Wetland Communities

Approximately 5,000 acres of regularly-flooded salt marsh, dominated by smooth cordgrass (Spartina alterniflora) were inventoried in the study area in 1968 by DNR. However, only those marshes exceeding five acres in size were included in the inventory. Keefe and Boynton (1973) defined three salt marsh communities in the study area: short S. alterniflora, short S. alterniflora with a minor amount of tall S. alterniflora, and short S. alterniflora, with a minor amount of salt grass (Distichlis spicata), and estimated the maximum standing crop of dead material and organic matter in each. Standing crops of S. alterniflora were less in Chincoteague Bay than in North Carolina and parts of Virginia but greater than in Delaware and New Jersey. This difference was attributed to differences in the length of the growing season (Keefe and Boynton, 1973).

Permanent open water in these marshes may support widgeon-grass (Ruppia maritima), eelgrass, (Zostera marina), sago pondweed (Potamogeton sp.), elodea (Elodea sp.) and coontail (Ceratophyllum demersum). Other closely associated plants are salt meadow cordgrass, hightide bush (Iva frutescens), myrtles (Myrica spp.) and glasswort (Salicornia sp.) (Metzgar, 1973).

Locally, this marsh type is used by feeding waterfowl, especially where vegetation-filled ponds are present. It is important habitat for gulls, rails, herons, mussels, snails, crabs, fish, and some shorebirds (Metzgar, 1973).

Marshes provide food and shelter, not only for organisms naturally inhabiting the marsh, but also for many organisms which spend part of their lives in the waters of the estuary and the remainder in the adjacent shallow ocean.

Approximately 80 acres of coastal shallow fresh marshes were inventoried in the study area by DNR, 1968. According to Metzgar (1973), these marshes occur on the landward side of coastal deep fresh marshes bordering tidal rivers, sounds, and estuaries. These wetlands are tidal and may be covered at average mean high tide by as much as six inches of water. The soil is always waterlogged during the growing season.

Vegetation consists mostly of cattail (Typha latifolia), reed (Phragmites communis), big cordgrass (Spartina cynosuroides), arrow-arum (Peltandra virginica), pickerel-weed (Pontederia cordata), golden club, three square, (Scirpus americanus), panic grass (Panicum sp.) and rose mallow (Hibiscus muscheutos). Other plants are millet (pennisetum glaucum), swamp rose (Rosa palustris), rice cut-grass (Leersia oryzoides), water-parsnip (Sium snave), water-hemp (Amaranthus cannabinus), saltmeadow cordgrass, saltmarsh cordgrass, myrtle, hightide bush (Iva frutescens), and groundsel bush (Baccharis halimifolia) (Metzgar, 1973).

These areas are used for feeding by waterfowl, shorebirds, and waders and also support mammals such as muskrats, raccoons and nutria (Metzgar, 1973).

Approximately 70 acres of inland open freshwater occurred in the study area in 1968 (DNR, 1968). According to Metzgar (1973), shallow water in artificial ponds, lakes and open areas interspersed in inland fresh marsh types are characteristic of this wetland type. Water depth is variable, and this wetland type is usually fringed by a border of emergent vegetation that grades into another type of wetland.

Vegetation (mainly at depths less than six feet, but scarce or absent in stained or turbid waters) consists of sago pondweed, naiad (Najas sp.) spatterdock, water-lily, smartweed (Polygonum hydropiper), elodea, water-willow (Decodon verticillatus), water cress (Nasturtium officinale), coontail, water milfoil (Myriophyllum spicatum), duckweed (Lemna sp.), arrowhead (Sagittaria sp.) burreed (Sparganium americanum), spikerush (Eleocharis sp.), native and introduced grasses and sedges, and various algal species (Metzgar, 1973).

Approximately 92 acres of shrub swamp were inventoried in the study area by DNR in 1968. Shrub swamps are normally waterlogged during the growing season and are covered with up to six or more inches of water (Metzgar, 1973). They often occur along sluggish streams and occasionally on river flood plains.

Vegetation consists of alder (Alnus sp.), button-bush (Cephalanthus occidentalis), willows (Salia spp.), small maples (Acer spp.), and sweetgums (Liquidambar styraciflua), tearthumb (Polygonum sagittatum), swamp rose, beggarticks, (Bidens sp.), beggar-lice (Desmodium sp.), jewelweed (Impatiens capensis), joe-pye-weed (Eupatorium maculatum), looserife (Lythrum spp.), native grasses and sedges (Metzgar, 1973).

This wetland type is used moderately by mallard, black and other puddle ducks during migration and is most important to wood ducks for nesting and nightly roosting. Rabbit, raccoon, opossum, fox, squirrel, otter, muskrat and deer find these areas to be valuable habitat as well as numerous reptiles, amphibians and resident and migratory songbirds (Metzgar, 1973).

Approximately 566 acres of wooded swamp occur within the study area (MDSP, 1973). Wooded swamps often occur in association with shrub swamps and along sluggish streams, on flood plains, on flat, poorly drained uplands, and in very shallow basins (Metzgar, 1973).

The soil is waterlogged to within a few inches of its surface during the growing season, and is often covered with a few inches of water in uplands

and up to one foot of water near streams and rivers (Metzgar, 1973).

Vegetation consists mainly of trees. Principal representatives are red maple, river birch, (Betula nigra), sweetgum, and pinoak (Quercus palustris). Other trees such as sycamore (Platanus occidentalis), oaks, elms (Ulmus spp.) ash, (Fraxinus spp.), aspen (Populus sp.), poplar (Liquidambar styraciflua), black gum (Nyssa sylvatica), and maples occur in variable numbers. Forest floor growth includes nettle (Urtica sp.), lizard's tail (Saururus cernuus), spicebush (Lindera benzoin), magnolia (Magnolia sp.), paw-paw (Asimina triloba), winterberry (Mitchella repens), greenbrier (Smilax sp.), holly (Ilex opaca), honeysuckle (Lonicera japonica), blackberry (Rubus sp.), grapes (Vitis sp.), beggarticks, jewelweed, various grasses, sedges and broad-leaved plants (Metzgar, 1973).

Wooded swamps provide habitat for numerous waterfowl, wildlife, and fish species (Metzgar, 1973). A few examples of each include use by puddle ducks for resting and feeding, but most importantly for black and wood duck nesting, brood production and nightly roosting. Other bird activities include migratory stops by mourning doves and woodcock, complete life cycle use by great blue herons, egrets, ibis, killdeer, sandpipers, and large number of resident and migratory songbirds. Deer, rabbit, squirrel, muskrat, otter, opossum and fox also utilize this wetland type. Several resident game fishes such as large mouth bass, pickerel, catfish, white perch, and yellow perch occur in permanently-watered areas.

Comprehensive lists of all birds, mammals, and herpetofauna expected to occur in the marshes and swamps are presented in Tables A-1 through A-4 in Appendix A.

3) Forest Communities

Nine forest communities were delineated in the North Central Ocean Basin for the MDSP by the Earth Satellite Corporation (Figure II-11): upland evergreen, mixed, and deciduous; lowland evergreen, mixed, and deciduous; evergreen, deciduous, and forested wetland (swamps). Since forested wetlands (both tree and shrub) were discussed in the previous section, they will not be described here. Evergreen, mixed, and deciduous forests are stages of secondary succession eventually culminating with the oak-hickory climax

(Braun, 1950). Wooded areas most recently disturbed, both upland and lowland, are almost exclusively inhabited by loblolly (Pinus taeda) and scrub pine (P. virginiana). In Deciduous trees species have invaded older coniferous stands with species type depending upon soil conditions. Mixed-upland communities on clay soils are usually characterized by willow oak (Quercus phellos), white oak (Q. alba), sweetgum (Liquidambar styraciflua), red maple (Acer rubrum), Spanish oak (Q. falcata), Black gum (Nyssa sylvatica), and black haw (Viburnum prunifolium) (Shreve et al., 1910). Sandy-loam soil communities usually contain spanish oak, white oak, black oak (Q. velutina), post oak (Q. stellata), black jack oak (Q. marilandica), willow oak, sweetgum, pig-nut hickory (Carya glabra), sassafras (Sassafras albidum), and dogwood (Cornus florida). Blueberry (Vaccinium corymbosum), huckleberry (Gaylussacia resinosa), and wax myrtle (Myrica cerifera) are the characteristic subdominants on both clay and sandy loam soils.

Mixed lowland forests usually contain sweetgum, red maple, willow oak, pin oak (Q. palustris), black gum. Tulip poplar (Liriodendron tulipifera) and beech (Fagus grandifolia) may occur in "areas seldom reached by high water" (Braun, 1950). The deciduous stage is signified by the loss of pines and the codominance of hickories (Carya spp.) with the oaks.

Comprehensive lists of all birds, mammals, and herpetofauna expected to occur in the forest communities are presented in Appendix A.

b. Aquatic Communities

The principal constituents of the aquatic communities in the planning area are separated in the following discussions based upon their growth-form.

1) Algae

Wulff et al., (1968) collected thirty-five species of marine algae from the jetties at Ocean City Inlet during the summer of 1966

(Table A-5). Generally, the absence of firm substrate and the abrasive action of unconsolidated sediment on high energy beaches deters the establishment of attached seaweed.

Schwartz (1964) reported the occurrence of extensive beds of *Agardhiella* in the eastern portion of Assawoman Bay. *Enteromorpha intestinalis*, *Enteromorpha* sp., *Chaetomorpha acraea*, *Ceramium rubrum*, *Gracilaria ferox*, and *Ulva lactuca* are abundant throughout the bay but are especially abundant in northern Assawoman Bay. Moul (1958) observed 25 algal species in Chincoteague Bay, Maryland. Because of the close proximity of this bay to the North Central Ocean Basin most or all species can be expected to occur within the bays in the study area and are listed in Table A-6.

2) Aquatic Vascular Plants

Eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) are the dominant aquatic vascular plants in Assawoman, Isle of Wight, and Sinepuxent Bays (Anderson, 1970; Schwartz, 1964). Much of the eelgrass population was destroyed during the "wasting disease" epidemic in 1931 but is now recovering to original levels. Eelgrass predominates in deeper water (Anderson, 1970) probably because of its sensitivity to low light (Setchell, 1920; Phillips, 1960).

Eelgrass forms the most important north temperate sea grass system (Phillips, 1974). The eelgrass system is a complex assemblage that fills multiple functional roles in coastal ecosystems, providing microhabitats for animals, substrata for epifauna, and epiphytes and protection for many species, especially juvenile forms (Orth, 1973). Eelgrass also stabilizes bottom sediments, reduces shore erosion and is an important source of organic detritus (Adams and Angelovic, 1970). Eelgrass communities now appear to be an important biochemical pathway in estuarine ecosystems by "pumping reactive

phosphorus from the sediments to the water column" (McRoy, Barsdate, and Nebert, 1972). Allee (1923) found anemones, encrusting bryozoa, hydroids, isopods, protozoa (ciliates and flagellates), and small crabs epiphytic to eelgrass leaves. The scallop (Pecten irradians) is attached during its larval stage (Davenport, 1903). The leaves also form a substrate for bacteria (Zenkivitch, 1963; Carriker, 1967). Davis (1911) listed 42 species of plants occurring on eelgrass in the Woods Hole, Massachusetts area. Wood (1959) recorded a long list of epiphytic algae species on eelgrass leaves, on each other, on animals in eelgrass beds in Australia, and on the mud surface. He also included a list of species which feed upon diatoms. Other epibiota which have been found include snails, amphipods, ostracods, polychaetes, nematodes, copepods, and mites (Nagle, 1965). Fish and crustaceans such as amphipods, copepods, and cladocerans are common. Blegvad (1916) found a great number of bacteria and detritus feeders on the mud surface of eelgrass beds in Denmark, i.e., crabs, many different molluscs, worms, fish, shrimp, amphipods, rotifers, nematodes, cucumbers, brittle stars, starfish, sea urchins, and sea-pens. Burrowing forms include worms, molluscs, brittle stars, cucumber, and some crustaceans.

All parts of eelgrass and wigeon grass are utilized for food by both indigenous and migratory waterfowl. Rootstocks and foliage of eelgrass are fed upon by the sea brant and the Canada goose while foliage and seeds are utilized by 25 species of waterfowl such as black duck and mallard. Twenty-two waterfowl species, including mallard, black duck, pintail, various teals, two species of geese, and swan, depend upon wigeon grass as a major source of food (Anderson, 1970).

Oceanic vascular plants do not occur in the study area (Muenscher, 1967).

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3) Fish

Seventy species of fish representing 57 genera and 39 families were collected by Richards & Castagna (1970) from stations located in barrier island inlets, channels midway between inlets and shore, in-shore beaches, and tidal creeks on Virginia's Eastern Shore (Table A-7). Most of those species can also be expected to occur within the North Central Ocean Basin. Eleven species were considered residents (Table II-13), and fifty nine species were designated as migrants. Resident species occur in these waters during at least three seasons each year.

Table II-13. Resident Fish Species in Virginia Coastal Waters [Source: Richards and Castagna (1970)].

<u>Common Name</u>	<u>Scientific Name</u>
Bay anchovy	<i>Anchoa mitchilli</i>
Sheepshead minnow	<i>Cyprinodon variegatus</i>
Mummichog	<i>Fundulus heteroclitus</i>
Spotfin killifish	<i>F. luciae</i>
Striped killifish	<i>F. majalis</i>
Rainwater killifish	<i>Lucania parva</i>
Northern pipefish	<i>Syngnathus fuscus</i>
Naked goby	<i>Gobiosoma boscii</i>
Atlantic silverside	<i>Menidia menidia</i>
Smallmouth flounder	<i>Etropus microstomus</i>
Oyster toadfish	<i>Opsanus tau</i>

Ten species comprised 97.8 percent of the total number of fish caught (Table II-14). The five most numerous are residents and forage species.

A total of 126 species of fish are known to have occupies the Isle of Wight Bay - Assawoman bay and Sinepuxent Bay - Chincoteague Bay systems (Schwartz, 1964) (Table A-8). Of these, 104 species were found by Schwartz (1964) in the former complex and 65 species in the latter.

Table II-14. The Ten Most Abundant Fish Collected in Seaside Waters of Virginia's Eastern Shore. [Source: Richards and Castagna (1970)].

<u>Common Name</u>	<u>Quantity Collected</u>
Atlantic silverside <i>Menidia menidia</i>	30,424
Mummichog <i>Fundulus heteroclitus</i>	13,800
Striped killifish <i>F. majalis</i>	8,590
Sheepshead minnow <i>Cyprinodon variegatus</i>	4,893
Bay anchovy <i>Anchoa mitchilli</i>	3,840
Silver perch <i>Bairdiella chrysura</i>	1,077
Atlantic menhaden <i>Brevoortia tyrannus</i>	1,057
White mullet <i>Mugil curema</i>	504
Striped mullet <i>M. cephalus</i>	423
Winter flounder <i>Pseudopleuronectes americanus</i>	203

Before the opening of Ocean City Inlet in 1933, freshwater species such as pike, catfish, yellow perch, and herring comprised the commercial catches of the Isle of Wight Bay - Assawoman Bay complex (Murphy, 1960). Shad, alewives, pike, yellow perch, white perch, and catfish predominantly comprised the commercial catches in the Chincoteague Bay - Sinepuxent Bay system. Higher salinities induced by inlet opening have reduced many of these populations to low levels or relicts.

Schwartz (1961) found an oscillation of populations in Sinepuxent Bay and Chincoteague Bay. Winter flounder, hogchoaker, and forage species such as silversides and anchovies occupied the bays during winter and were replaced by spotted hake and summer flounder during summer. Black

sea bass overlapped the above from April to November. By June, spot move in but later are replaced by weakfish, porcupine fish, wellfish and lizardfish. During periods of normal high and spring high tides, occasional butterfly fish (*Chaetodon ocellatus*) were observed. Ocean City Inlet was characteristically populated by sharks, rays, skates, summer flounder, kingfish and bluefish.

The extensive marshes and eelgrass and algae beds in the bays serve as excellent nursery grounds for young of the spot, weakfish, silver perch, summer flounder, anchovies, black sea bass, and numerous species of small fish such as gobies, blennies, and killifish (Schwartz, 1961; 1964).

4) Waterfowl

Waterfowl ground and aerial surveys conducted in 1973-1975 are summarized in Tables A-9 and A-10, respectively (Maryland DNR, Wildlife Administration, 1973-1975). Ground surveys, overlooking the Atlantic Ocean at Assateague Island State Park, were executed weekly, spanning three-hour periods after sunrise and prior to sunset, from mid-September to mid-November. Aerial surveys were made between late September and early November along a transect 500 yards offshore in the Atlantic Ocean and along bisects in Assawoman, Isle of Wight, and Sinepuxent Bays, each located 1,500 yards from shore.

Waterfowl abundance in the bays was extremely variable for most species (Table A-10). Note the substantially greater numbers of brant, geese, and swan in each bay in 1973 and that these species seem to favor Sinepuxent Bay. Peak numbers of waterfowl were abnormally low all three years. Surf scoters were the predominant oceanic species during peak movements (between October 2-10) with common scoters second in abundance. White-wings and old squaws occurred in substantially fewer numbers.

5) Benthic Invertebrates

The faunal composition of the benthic community offshore from the Delaware/Maryland Coast is normally uniform (DuPont et al., 1972). The sand dollar (Echinarachnium parma) dominates the area in number and biomass. Other organisms which are also abundant in the area include the sand shrimp (Crangon septemspinosus), the ascidean (Bostrichobranchus pilularis) and the arenaceous foraminifera (Astrorhiza sp.).

Other common benthic invertebrates in the area include the sea stars (Asterias forbesi and A. vulgaris), a yellow sponge, the heart clam (Cardita borealis), the mahogany clam (Arctica islandica), clam drill (Lunatia heros), a small snail (Solarrella obscura), an amphipod (Unicola virostrata), an isopod (Edotea montosa), the rock crab (Cancer irroratus), the hermit crab (Pagurus annulipes), and a shrimp (Hippolyte sp.).

The community structure of the macrobenthos does not change significantly throughout the year. Only the rock crab population displays substantial seasonal recruitment, and that occurs during August. Rock crabs appear to migrate close to shore during the winter and occur in the vicinity of the Ocean City Inlet (Casey, 1977, personal communication).

The benthic communities of the coastal bays in the study area have not been characterized, except for Sinepuxent Bay. There are, however, considerable data for similar coastal environments to the north (Rehoboth Bay, Delaware) and to the south (Chincoteague Bay).

Humphries (1967; cited in Kraft, 1971) found 51 taxa of benthic organisms in Rehoboth Bay (Table A-11) and surveyed their presence or absence in or on muddy sand, mud, and clean sand. Of the taxa surveyed, most (27) were found in clean sand and at least (19) appeared in mud. Twenty-one taxa were found in muddy sand. Thirteen taxa were found exclusively in clean sand; twelve appeared exclusively in the muddy sand, and seven were found only in the mud. Invertebrate sampling in tributaries of Little Assawoman Bay disclosed the presence of the blue crab, Callinectes sapidus, and benthic organisms including Nereis sp.,

Heteromastus filiformis, Scolopelos armiger, and Leptocheirus plumulosus.

Approximately 64 species of benthic invertebrates (Table A-12) (Drobeck et al., 1970), and 18 species of decapod crustaceans (Table A-13) (Leber & Lippson, 1970) have been collected in Chincoteague Bay. The interrelationship of benthic species formed a complex web which did not permit delineation of communities.

The most abundant decapod was C. sapidus. Other abundant species included Neopanope texana sayi and Crangon septemspinosa. Four semi-terrestrial species were abundant in the area and included Uca pugilator, U. pugnax, Ocypode quadrata, and Emerita talpoida. Marine species appeared near inlets, and the most abundant of these species were Pagurus pollicaris and Ovalipes ocellatus.

6) Zooplankton

The zooplankton community of the Atlantic Ocean offshore from the Delaware/Maryland Coast is dominated numerically and volumetrically by calanoid copepods (DuPont et al., 1972). Thirty-two species and four additional copepod genera were identified from the area. The community also contains cladocera, chaetognaths, pteropods, tunicates, and meroplanktonic larvae. Copepods were dominant throughout the year and attained their greatest diversity during October and November coincident with high phytoplankton diversity and destruction of the thermocline. Increases in diversity were also attributed to recruitment of warm water forms from southern waters. These species are replaced by cold water species during the winter. Species diversity is lowest during the late winter.

Seasonal variations in zooplankton abundance include peaks during the spring and early summer and during the autumn. Low abundance occurs during the winter and the summer. High abundance appears to be a response to seasonal phytoplankton blooms and influxes of meroplanktonic larvae. The principal components of the zooplankton community are summarized in Table A-14. Many of these species are present throughout the year. The spring-summer

community contains many of the dominant species plus indicators such as Acartia longiremis, Centropages hamatus, Metridia lucens, Temora longicornis, and Tortanus discandatus. Indicators of the late summer and autumn community include Corycaeus spp., Oncaea venusta, Acartia danae, Calocalanus pavo, Candacia armata, C. pachydactyle, Centropages turcatus, Copilia mirabilis, Eucalanus spp., Euchalta marina, Labidocera aestive, Nannocalanus minor, Supphirina nigromaculata, Solexithrix danae, Temora stylifera, T. turbinata, and Undinula vulgaris.

Meroplanktonic larvae appeared in the zooplankton community from late spring through the autumn. Prominent members of this group included pluteus larvae, veligers, and crab zoea. Crab zoea appeared from May to October, with maximum abundance in late May and June. Veligers were present from May to November. Maximum abundance of gastropod veligers occurred in May, and maximum abundance of bivalve veligers and post-veligers occurred in November. Pluteus larvae were present from May to November. Maximum abundance occurred in November.

The zooplankton community of the enclosed bays has not been surveyed. In Delaware Bay, the mixohaline-polyhaline zone (18-30 ‰) is dominated by Centrophages typicus, C. hamatus, Labidocera aestive, Temora longicornis, Penilia avirostris, Paracalanus parvus, and Evadne nordmanni. These normally coastal species enter the bays during the flooding period and feed upon the phytoplankton of the sheltered waters. A second zooplankton community dominates the mesohaline areas (5-18 ‰) of the bays. These areas are normally restricted to narrow zones of freshwater creeks entering the bays. This zooplankton community is dominated by Eurytemora hirundoides, E. affinis, Acartia tonsa, Pseudodiaptomus coronatus, and Neomysis americanus.

7) Phytoplankton

The oceanic phytoplankton community offshore from the Maryland/Delaware Coast is composed principally of dinoflagellates and diatoms (Dupont et al., 1972). Approximately 28 species, included in 17 genera, were identified in a survey of the area (Table A-15). Flaminifera and radiolarians were present occasionally but never in significant numbers. Blue-green algae were also identified in some samples.

A seasonal cycle of phytoplankton abundance occurs in the ocean waters. A spring-summer population appears from May to October. Ceratium tripos is the most abundant species in this dino-flagellate-dominated community. Secondarily abundant species include C. longpipes and C. fusus. Nutrient concentrations are generally low above the thermocline during this period. The number of species generally increases throughout the summer but the volume of phytoplankton appears to decrease to a minimum during August.

Species diversity is greatest during October and November, a transition period between dinoflagellate and diatom dominance.

Diatoms assume dominance of the phytoplankton community during the winter and early spring. During this period nutrient concentrations are high, and circulation is not restricted by the thermocline. No single diatom species dominates the community. Dominance is shared by Nitzschia seriata, Thalassiosira sp., Stephanopyxis turris, Rhizsolenia alata, and Guindaria flaccida.

The phytoplankton communities of the enclosed bays in the study area have not been surveyed. It is reasonable to assume that the species composition and seasonal trends are similar to that in the nearshore oceanic environment. Higher densities would, however, be expected in the bays than in the ocean.

c. Endangered Species

Peregrine Falcons, protected by Federal regulations, utilize Assateague Island for resting and feeding during spring and fall migration (Ward, 1977; Taylor, 1977). Fall immigration is from mid-September through mid-November with peak movements usually between September 25th and October 15th (Ward, 1977). Although spring use is not well known, preliminary data indicate a northward movement in April and early May (Ward, 1977).

An active bald eagle nesting area, also protected by Federal regulations, is located within the planning area south of Berlin (Taylor, 1977).

No plant species are presently listed as endangered by either Federal or Maryland State regulations (Taylor, 1977). However, the Department of Interior is considering several species to be given protection under Maryland regulations as stated in the Non-Game and Endangered Species Conservation Act of 1975 (Taylor, 1977). Lechea maritima var. virginica is under consideration and may occur in Hudsonia dominated dunes on Assateague Island (Higgins et al., 1971; Broom, 1977).

d. Potential Natural Areas

Seventeen potential natural upland areas (Table II-15) have been delineated in the North-Central Ocean Basin by the Maryland Department of Natural Resources (1975) (Figure II-14). A detailed description of each is available from DNR. One of the major purposes of a Natural Areas Inventory is to provide data on sites for state and federal agencies and departments which regulate or acquire land for particular uses. "Natural areas" are defined as "areas where, at present, natural processes predominate and are not significantly influenced by either deliberate manipulation or accidental interference by man (DNR, 1975). Streams, forests and non-tidal wetlands such as bogs, marshes, ponds, and swamps are included in the Inventory.

Table II-15. Potential Natural Upland Areas within the Planning Area [Source: DNR, 1975].

South Branch	Radio Tower Wetland
Birch Branch	Schwalb americana
Jenkins Neck	Kitt's Branch, Trappe
Turville Neck, Jake Gut	Mill Pond
Taylorville Pine Forest	Upper Ayer Creek
Turville Neck, Gum Point	Jenkin's Pond
Hastings Track	Trappe Creek Wood
Herring Creek	Maryland Beach Marsh
Isle of Wight	Bishopville Pond

e. Site-Specific Studies

Field studies were performed in all areas which would be impacted during construction of the applicant's selected plan.

1) Expansion of Ocean City Treatment Plant

Proposed expansion of the Ocean City sewage treatment plant to 12.0 mgd would occur within the limits of fill material. Figure II-4 a & b illustrate the paucity of vegetation on the proposed site. Expansion to 20.5 mgd would result in the filling of approximately 7.5 acres of bay bottom and salt marsh dominated by smooth cordgrass (Spartina alterniflora) and saltmeadow cordgrass (S. patens) (Figure II-4 c).

2) Proposed West Ocean City Sewage Treatment Plant Site

Woody vegetation in the proposed West Ocean City STP site was studied to determine community types and structure. Sampling methodologies and results are presented in Appendix B. The eastern portion of the site is inhabited by a mixture of hardwood and softwood species typical of upland areas. Scrub pine (Pinus virginiana) and loblolly (P. taeda) comprise the oldest and largest trees in the stand and are the dominant components of the canopy. This is not unexpected since these species are primary arborescent invaders in secondary succession (Braun, 1950). Although red maple (Acer rubrum) shares dominance in the overstory with the pines, individuals are smaller in dbh but larger in total numbers. Black oak (Quercus velutina) and white oak (Q. alba) are almost equally influential in the canopy. The former, however, comprises fewer but larger (dbh) individuals than the latter. Sweet gum and other oaks (red, Q. rubra, and Spanish red, Q. falcata) are less important in the canopy while mockernut hickory (Carya tomentosa) occurs as infrequent, smaller trees.

The shrub layer in the softwood-hardwood area is characterized by American holly (Ilex opaca), rhododendron (Rhododendron maximum), blueberry (Vaccinium corymbosum), and blackberries (Rubus spp.). Rhododendron forms dense stands in several different sections of this area similar to that shown in Figure II-5. Figure II-5 also typified the density of the vegetation for the area as a whole.



A

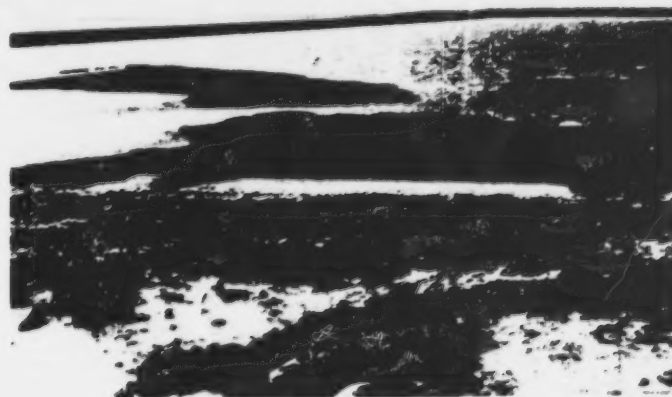
12.0 mgd Expansion Area - Ocean City STP



B

12.0 mgd Expansion Area - Ocean City STP

C



20.5 mgd Expansion Area - Ocean City STP

FIGURE II-4.
PROPOSED EXPANSION AREA FOR
OCEAN CITY STP



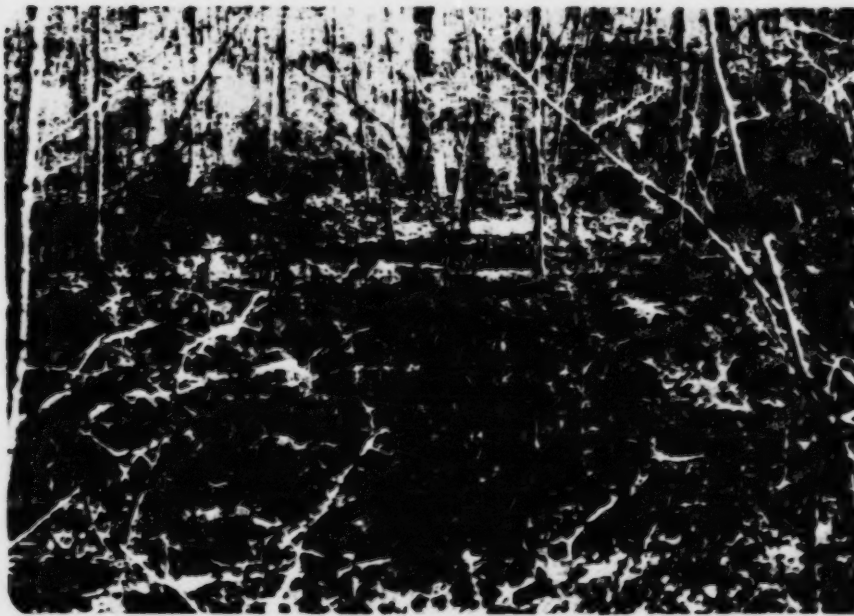
FIGURE II-5. SOFTWOOD/HARDWOOD COMMUNITY IN THE PORTION OF THE PROPOSED WEST OCEAN CITY STP SITE.

Based upon field observations and Braun (1950), natural succession is expected to proceed as follows:

Pine	-	Red Maple
	↓	
Red Maple	-	Oak
	↓	
Oak	-	Hickory (climax)

The western portion of the proposed site is composed of flat areas which were shallowly inundated during winter (generally less than six inches) and interspersed with abruptly rising hummocks seldom exceeding two feet in height and 10 feet in width. Arborescent vegetation of inundated areas is almost exclusively composed of red maple and sweet gum. Although sweet gum is less frequent than red maple, the former is substantially larger in total number and total basal area. Examination of the raw data proved sweet gum to be generally larger (dbh) than red maple. The significantly higher importance values of sweet gum indicates its dominance in the canopy. Most hummocks are dominated by white oak. Oaks of lesser importance include pin (*Q. palustris*), willow (*Q. phellos*), water (*Q. nigra*), and chestnut (*Q. michauxii*). Highest hummocks (relatively few in number) are inhabited by very large beech trees (*Fagus grandifolia*) approaching 2-1/2 feet dbh. Most shrubs seem to prefer plane-hummock interfaces. Characteristic species are American holly, wax myrtle (*Myrica cerifera*), blueberry, sweet bay (*Magnolia virginiana*), rhododendron, blackberries, and dogwood.

Figures II-6 A and B typify topography features and vegetation density and dispersion.



A

TWO VIEWS OF HARDWOOD COMMUNITY IN THE
WESTERN PORTION OF THE PROPOSED WEST
OCEAN CITY STP SITE



B

FIGURE II-6.
TYPICAL HARDWOOD COMMUN-
ITY AT THE WEST OCEAN
CITY PROPOSED STP SITE.

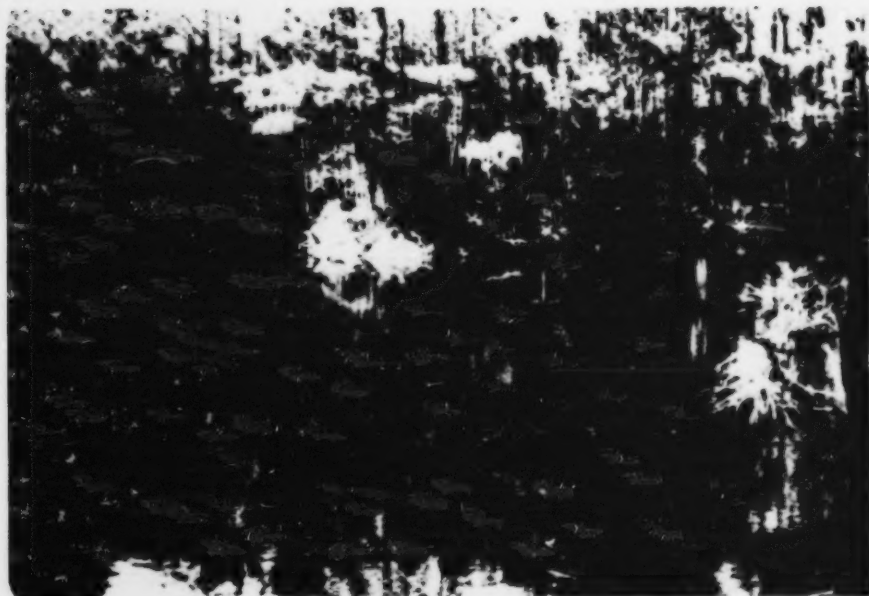
Two man-made ponds are also located within the site (Figure II-7). Both ponds are each less than one acre in size and are surrounded to water's edge, by near-pure loblolly and scrub pine stands.

Because of the diversity of habitat produced by dissimilar plant communities and pond occurrence, the proposed site offers excellent habitat for most mammalian, reptilian, and amphibian species which occur in the lower coastal plain. The latter two groups are particularly favored due to the presence of swampy areas and ponds. Pines, oaks, and hickories in the softwood/hardwood section provide favorite foods for squirrel and deer. The presence of both mammals was substantiated during field studies.

3) Pump Stations, Force Mains, and Interceptors

The proposed pump station site on Route 50 between Routes 113 and 589 is located in agricultural land. The Jenkins Neck site on Route 90 is positioned within the existing Ocean Pines' treatment plant property. The proposed pumping station site on Route 50 between Route 611 and Sinepuxent Bay is located on lawn. The proposed Herring Creek pump station is located within a disturbed woodland stand whose canopy is characterized by white, red, black, water oaks, and red maple. Characteristic species of the shrub layer are American holly and dogwood. Japanese honeysuckle and green briars dominate the herbaceous layer. Disturbance is probably attributable to activities associated with an adjacent picnic area and motel/cottage complex. No animal tracks, dens, or nests were noted within the proposed site and the immediate surroundings.

Most proposed force mains and interceptors lie within roadway and railroad right-of-ways and residential lawns. A notable exception is the Herring Creek crossing. The east and west banks of the creek contain regularly flooded salt marshes located at the toe of the roadway embankment. The intertidal zone is inhabited almost exclusively by smooth cordgrass (Spartina alterniflora). The storm tide zone is characterized by silverling (Baccharis halimifolia), marsh elder (Iva frutescens), sea lavender (Limonium carolinianum), fox-tails (Cynodon spp.), panic grass (Panicum spp.), and marsh aster (Aster tenuifolia). Total areal extent of both marshes is less than 0.25 acre.



A



B

FIGURE II-7. ARTIFICIAL PONDS AT THE PROPOSED WEST OCEAN CITY STP SITE.

4) Ocean Outfall

Figure II-8 A - G illustrates the route of the proposed ocean outfall. Beginning near the West Ocean City parking lot (Figure II-8 A-C), the proposed outfall would traverse approximately 1,500 feet of grassland dominated by bluegrass (Poa, sp.), panic grass (Panicum spp.), broom sedge (Andropogon virginicus) crabgrass (Digitaria sanguinalis), and wooly hudsonia (Hudsonia tomentosa). The shrub zone (silverling and marsh elder) in Figure II-8 C represents the boundary between grassland and marsh. The entire marsh is shown in Figure II-8 F. The western sector of the marsh (approximately 81 feet wide) is dominated by saltmeadow cordgrass (Spartina patens). Although most regions of this community are inhabited almost exclusively by saltmeadow cordgrass; silverling, marsh elder, marsh aster, and smooth cordgrass occur infrequently. The eastern sector, between the salt meadow cordgrass community and Sinepuxent Bay, is inhabited by a smooth cordgrass (S. alterniflora) dominated community (approximately 252 feet wide). (Figure II-8 G). Figure II-8 G illustrates the discrete zonation of the two communities.

The smooth cordgrass community is interrupted about midway by a drainage ditch which inhibits flooding of the upper (western) section. The ditch is signified in Figure II-8 G by the row of silverling and marsh elder shrubs. This has apparently resulted in the addition of species such as salt wort (Salicornia sp.) and sea lavender (Limonium carolinianum) to the community. The area below (east) the drainage ditch is occupied exclusively by smooth cordgrass.

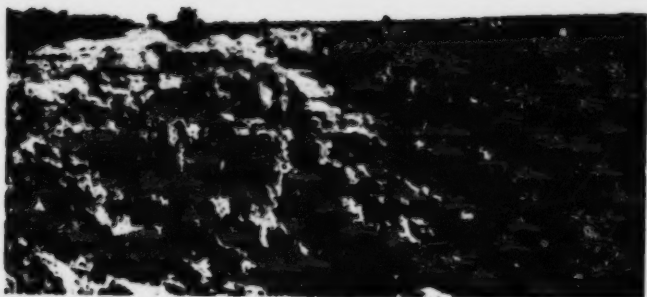
Figure II-9 A thru I traces the route of the proposed outfall across Assateague Island. The barren oceanic beach is shown in Figure II-9 A and B. Perennial vegetation of the foredune (Figure II-9 C) is exclusively American beachgrass (Ammophila breviligulata). Figure II-9 D shows the sand flat, barren of perennial vegetation, located immediately west of the foredune. The dark zone beyond the barren sand flat is a salt flat dominated by smooth cordgrass. Beyond the salt flat is a saltmeadow cordgrass/American beachgrass dominated dune. A second salt flat occurs beyond this dune and grades into another salt meadow cordgrass/American beachgrass dominated dune.



A



B



C



D

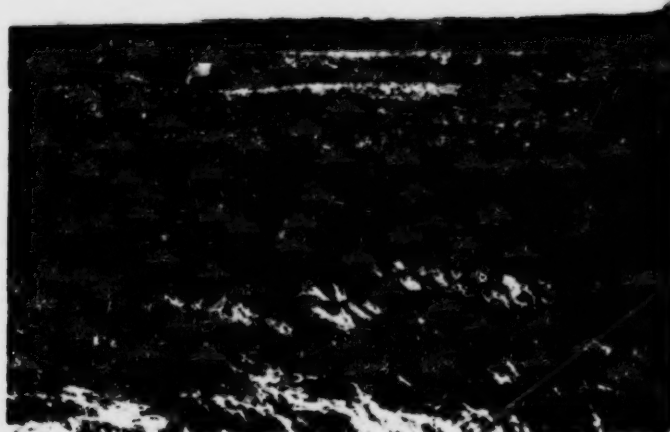
FIGURE II-8.
PROPOSED OUTFALL ROUTE
ACROSS THE MAINLAND.



E



F

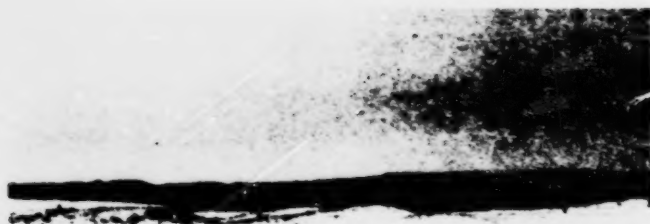


G

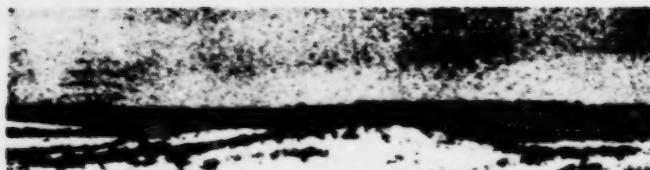
FIGURE II-8. CONTINUED



A



B



C

FIGURE II-9.
PROPOSED OUTFALL ROUTE
ACROSS ASSATEAGUE ISLAND



D

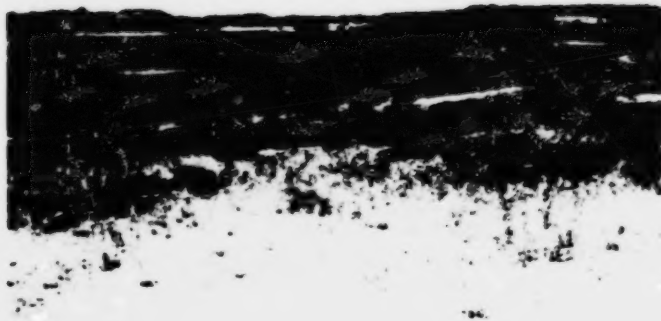


E



F

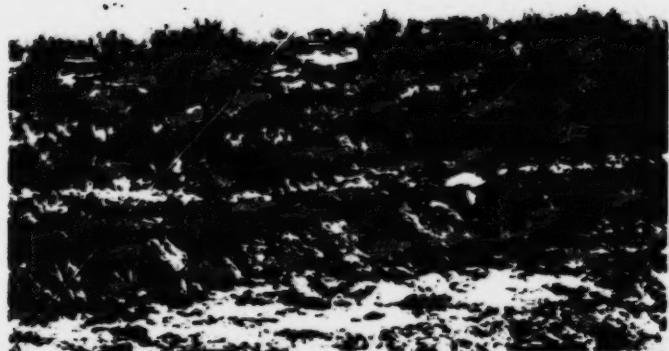
FIGURE II-9. CONTINUED



G



H



I

FIGURE II-9. CONTINUED

A third salt flat (Figure II-9 H) occurs beyond this dune and is separated from the bay by a narrow shrub dominated dune zone and a narrow zone of smooth cordgrass (Figure II-9 I).

A transect was established along the proposed route to determine the constituents of each community and to approximate winter percent cover and width of each. It must be emphasized that the species lists are not complete because sampling occurred during late winter. A profile of the transect, with delineation of plant communities, is provided in Figure II-10 (contours are approximate and relative). Perennial constituents and percent cover values of each community are presented in Table II-16.

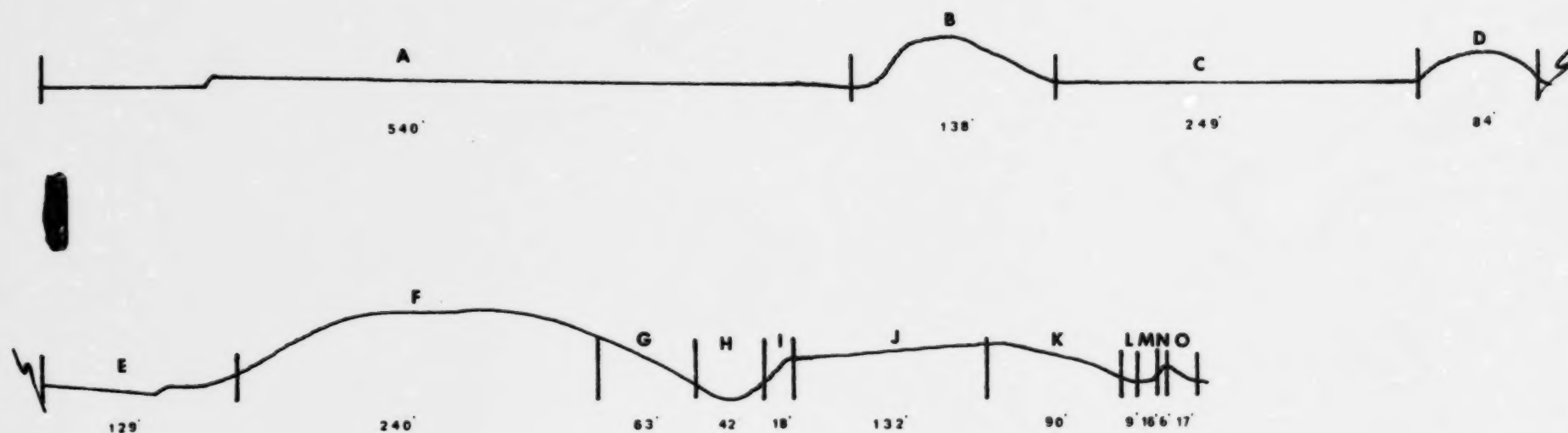


FIGURE II-10. OCEAN OUTFALL TRANSECT PROFILE WITH DELINEATION OF PLANT ZONES. CONTOURS ARE APPROXIMATE AND RELATIVE. ZONE WIDTH, COMPOSITION AND PERCENTAGE OF COVER ARE PRESENTED IN TABLE II-16.

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II-60

Table II-16. Approximate Width, Plant Composition, and Percent Cover for each Zone Delineated in Figure II-10.

<u>ZONE</u>	<u>PLANT COMMUNITY TYPE</u>	<u>APPROX. WIDTH (Feet)</u>	<u>COMPOSITION</u>	<u>APPROX. PERCENT COVER</u>
A	Barren Oceanic Beach	540'	None	0
B	American beachgrass Foredune	138	American Beachgrass	25
C	Barren Sand Flat	249	None	0
D	American beachgrass Dune	84	American Beachgrass	25
E	Salt Flat	129	Smooth cordgrass, Saltwort, Marsh aster, and Sea Lavender	100
F	Saltmeadow cordgrass Bayberry Dune	240	Saltmeadow cordgrass, Bayberry, Amer- ican beachgrass	50
G	Saltmeadow cordgrass-sedge Dune	63	Saltmeadow cordgrass, Common three- square, Bayberry, Salt Grass, Rush	75-100
H	Salt Flat	42	Smooth cordgrass, Saltwort, Salt grass, Rush	100
I	Saltmeadow cordgrass-Bayberry Dune	18	Saltmeadow cordgrass, Bayberry	50-75
J	American beachgrass Dune	132	American beachgrass, Evening primrose, Bayberry	25-50
K	Saltmeadow cordgrass Dune	90	Saltmeadow cordgrass, Seaside goldenrod	50-75
L	Shrub-sedge-grass Dune	9	Marsh elder, Saltmeadow cordgrass, Common three-square, Smooth cordgrass, Seaside Goldenrod, Rush	100
M	Salt Marsh	16	Smooth cordgrass, Seaside Goldenrod, Sea Lavender, Saltwort, Marsh aster	
N	Shrub-grass Dune	6	Marsh Elder, Saltmeadow cordgrass, Smooth cordgrass, Seaside Goldenrod, Panic grass, Sea Lavender, Saltwort	100
O	Bay Beach Marsh	17	Smooth cordgrass	50

7. Noise

Ambient noise is generally low throughout most of the study area due to the lack of noise sources. Ocean City Airport is the major single noise source in the study area. Much of the area is rural and noise levels are typical of such an environment. No noise pollution problems have been reported in the study area (George Durden, BAQNC, 1977, Personal Communication).

The main sources of noise are associated with the seasonal influx of tourists (COE, 1976). Vehicular traffic, boating, and beach activities all increase noise levels at specific locations throughout the study area. COE (1976) proposed the following general noise levels for various locations in the study area.

- 75-80 dBA - 100 feet from a major highway such as Route 50 on a summer weekend
- 57 dBA - maximum background from traffic in a residential area near the center of a city such as Ocean City
- 65-105 dBA - maximum noise from pleasure boats at 50 feet in congested areas such as the Ocean City Inlet
- 60 dBA - average noise on a popular beach
- 55 dBA - average noise in a residential area bordering a popular beach
- 50-75 dBA - average to maximum noise in residential areas bordering an airport such as the Ocean City Airport

B. SOCIAL AND ECONOMIC ENVIRONMENT

The following sections contain a description of the current social and economic character of the primary and peripheral study areas. Information presented in this section includes population, land use, economics, public services, historic and archaeological resources and aesthetics. This information provides the basis for projecting the impacts of the applicant's proposed project upon the social and economic character of the primary and peripheral study areas (Section IV).

1. Population

The Worcester County and North Central Ocean Basin are principally rural. In 1970 Worcester County (including Berlin and Ocean City) contained 24,442 permanent residents (Table II-17). Approximately 30 percent of these people resided within the study area (GMB, 1976). Two incorporated towns, Berlin and Ocean City, are the basin's population centers. The basin's total population consists both of a small permanent and a large seasonal population. Morton Hoffman Associates (1972) and recent "Demoflush" statistics from Ocean City indicate that during the months of May through September approximately 100,000 visitors enter Worcester County. Approximately 100,000 to 200,000 people may visit the County during summer weekends and holidays. Approximately two-thirds of these visitors spend at least one night in the County; the remaining one-third usually spend only the day (GMB, 1976). Approximately 72 percent of all visitors come to Ocean City while another 12 percent visit the Sinepuxent Peninsula area (GMB, 1976). The remaining visitors are distributed among the county's other waterfront lands and park areas (GMB, 1976).

Table II-17. Population Changes in Worcester County and the Three Election Districts Containing the North Central Ocean Basin from 1930 through 1970 [Source: MDSP (1971)].

<u>Election District</u>	<u>1930</u>	<u>1940</u>	<u>1950</u>	<u>1960</u>	<u>1970</u>
3 (Berlin)	4,592	2,888	3,578	6,195	6,136
5 (St. Martin)	1,374	1,451	1,579	1,599	1,485
10 (Ocean City)	N/A	2,037	2,508	2,712	3,510
Worcester County	21,624	21,245	23,733	23,733	24,442

The permanent resident population in Worcester County has been relatively stable principally because of the County's distance from large urban areas, and the predominately agricultural economy (COE, 1976). Worcester County's average annual growth rate from 1930 to 1975 was 0.33 percent which is substantially less than the 3.5 percent average annual growth rate experienced by the State of Maryland during the same period. Worcester County's 1970 population density of 51 people per square mile was one of the lowest in the State of Maryland (MDSP, 1975).

Although the past population growth rate of the County has been relatively stable, more rapid growth has occurred recently because of the County's attractiveness as a retirement area due to the rural lifestyle and the variety of water-based recreational opportunities (COE, 1976). A continuing trend toward settlement by elderly residents is anticipated (COE, 1976). In 1970, the percentage of people 60 years old and older comprised 17.3 percent of the total County population. By 1990, the percentage of people over 60 years in Worcester County is anticipated to increase to 19.7 percent (COE, 1976). A second growth promoting factor is the County's steadily expanding resort industry. Increased tourism has created employment opportunities and reduced emigration. A third source of population growth is urban expansion resulting from increasing industrialization throughout the Delmarva Peninsula (COE, 1976).

Areas in the county with high rates of growth include the bay-shore regions and Ocean City. Major developments include Ocean Pines, Mystic Harbour, and similar second-home communities. The inland sections of Worcester County are anticipated to continue their present slow rates of development due to their agricultural potential and their distance from concentrated urban and recreational activities (COE, 1976).

Ocean City is Maryland's principal ocean resort and has experienced rapid growth during the past decade. Each year the City experiences the usual seasonal fluctuations in population associated with resort areas. The 1970 census described Ocean City's permanent resident population but provided no information about the size of the permanent-residual visitor population. The number of winter and fall residents (October-March) has been also increasing steadily since 1971 (Table II-18). This rapid increase is in all probability due to the development of large condominium units which have caused owners to visit throughout the year.

Table II-18. Estimated Winter and Fall Populations in Ocean City.
[Source: Leonard Kilbourne, City Health Service Director, Ocean City, Maryland, 1977, Personal Communication].

<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
5,900	8,400	10,350	10,266	14,066	17,550

* Based on January-March and October-December Monthly Averages.

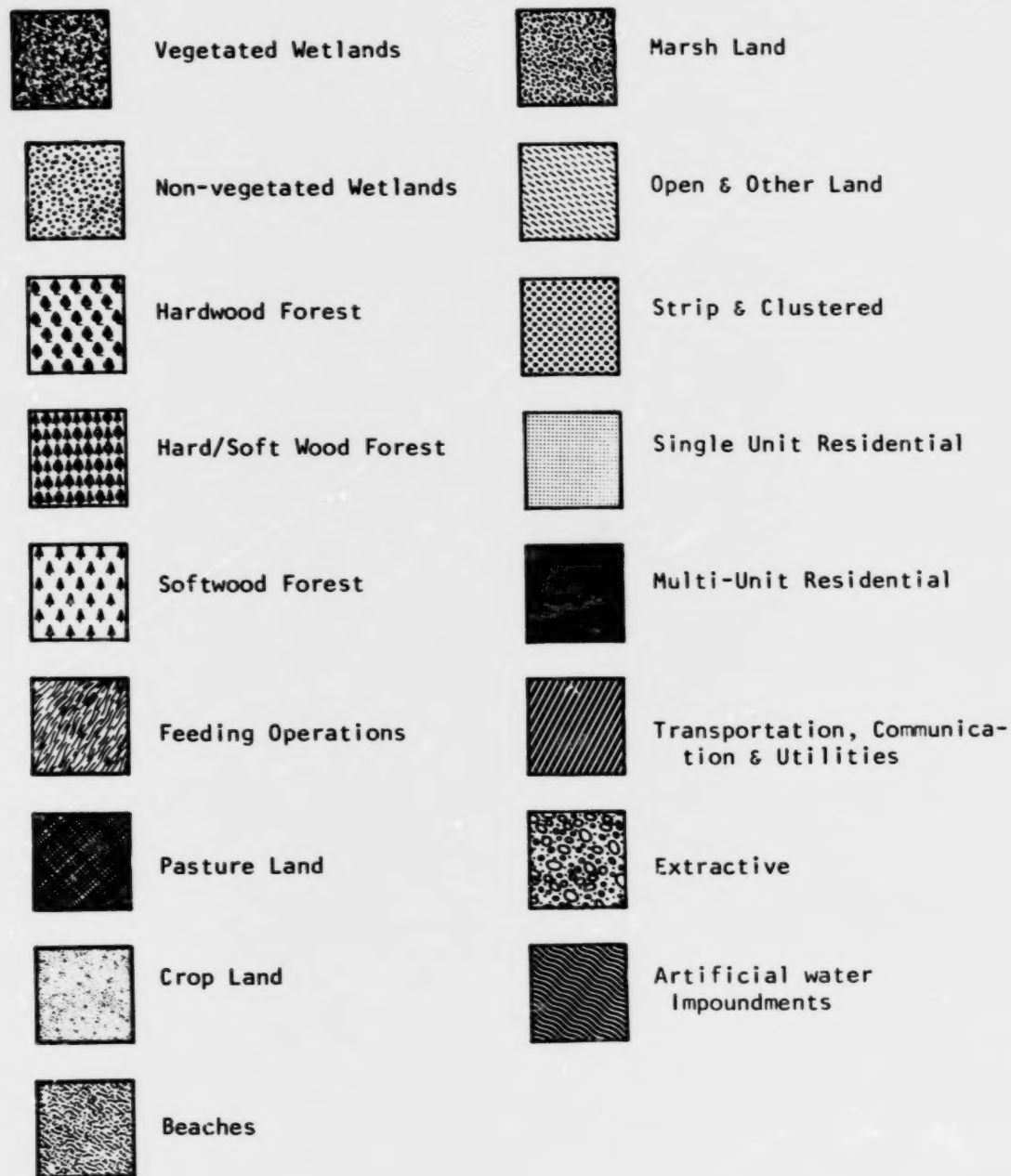
A model, developed to estimate seasonal population, is being utilized by planning officials in Ocean City (Goldschmidt & Dahl, Undated). In this model, "Demoflush", wastewater flow is transformed into a population estimate. The Demoflush model estimated that Ocean City's peak summertime population (August-monthly average) in 1971 was 100,000 people and by 1976 this population had increased to 179,000 people. This represents an average annual increase of summertime visitors of 12.3 percent per year.

2. Existing Land Use

Land uses in the study area were determined from land use data prepared by the Earth Satellite Corporation for MDSP in 1973. Agricultural, natural, and undeveloped areas occupy approximately 85 percent of the basin. Approximately two-thirds of the remaining land has been developed for single-family residences. The remaining land has been developed primarily for urban and commercial uses (Figure II-11).

Forests, Wetlands, Open Space. These land uses occupy 31,673 acres or 47.0 percent of the North Central Ocean Basin (Table II-19). This category includes forest land, wetlands, reservoirs, and beaches. Forest land occupies 22,595 acres and includes all land at least ten percent stocked with trees, land dedicated to forest production but temporarily cleared by logging, and abandoned fields where the presence of woody brush prevents classification as agricultural (MDSP, 1974). Land classified as forested occurs only on the mainland in irregular parcels interspersed with croplands. Wetlands occupy 7,712 acres and include both vegetated tidal marshes and unvegetated tidal flats. Wetlands occur continuously along the bay shore of Assateague Island and intermittently along the bay shore of Ocean City. Extensive wetlands also border the western margin of Assawoman Bay and all sides of Newport Bay on the western side of Sinepuxent Neck. Scattered concentrations of wetlands also occur along the mainland shoreline of Isle of Wight and Sinepuxent Bays. Reservoirs occupy 134 acres of the study area. Approximately 214 acres of beach occur along Ocean City. The remaining 1,018 acres of beach occur on Assateague Island.

Agricultural. Agricultural lands occupy 25,289 acres and include cropland, pasture, and animal feeding operations (Table II-19). Most of the agricultural land in the study area is cropland (24,345 acres). Only 1.4 percent of the study area (944 acres) is used for pasture and animal feeding. Agricultural land is confined to the mainland and occurs in broken parcels of varying sizes. However, approximately two-thirds of the agricultural land in the study area is concentrated in the northwestern portion of the study area north of the Route 50 corridor (Figure II-11).



LEGEND FOR FIGURE 11-11



FIGURE II-11. EXISTING LAND USE IN THE
NORTH CENTRAL OCEAN BASIN.
[SOURCE: MDSP (1974)].

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Table II-19. Existing Land Uses in the North Central Ocean Basin. [Source: Maryland Department of State Planning, 1974].

	<u>Acres</u>	<u>Percent</u>		<u>Acres</u>	<u>Percent</u>
Forests, Wetlands, Open Space	31,673	47.0	Forests	22,595	33.5
			Reservoirs	134	0.2
			Wetlands	7,712	11.4
			Beaches	1,232	1.8
Agricultural	25,289	37.5	Crops	24,345	36.1
			Pasture	944	1.4
Urban and Strip Development	2,432	3.6	Strip Develop- ment	1,955	2.9
			Open Urban	477	0.7
Commercial	86	0.1	Commercial	86	0.1
Institutional/ Educational	164	0.2	Institutional/Ed- ucational	164	0.2
Residential	7,042	10.5	Low Density- Single-Family	5,570	8.3
			Medium Density Single-Family	1,126	1.7
			Mobile Homes	346	.5
Miscellaneous	685	1.0	Transp./Utilities	461	.7
			Sand/Gravel Pits	224	.3
Total	67,371	99.9	Total	67,371	100.0

Urban and Strip Development. This category includes open urban areas such as vacant lots or parking areas, and areas of strip development along transportation routes where residential, commercial, and other developed uses become thoroughly mixed. These areas occupy 2,432 acres of the study area (Table II-19). Most of the developed area of Ocean City between the ocean beach and Isle of Wight Bay is classified as strip development. Scattered open urban areas occur in Ocean City, around Berlin, along the Route 50 corridor, and occasionally on lower Sinepuxent Neck. The residential subdivision of Ocean Pines, and Assateague Island each include a small parcel of land categorized as open urban.

Commercial. Small parcels of land classified as retail-commercial occur in Ocean City (32 acres) and Berlin (54 acres). Some small businesses scattered along transportation corridors are not sufficiently extensive for satellite mapping. Therefore, actual acreage of commercial uses is probably higher than these figures indicate. This land use category occupies approximately .1% of the study area (Table II-19).

Institutional/Educational. Schools, churches, medical and government facilities are included in this category. They occupy 164 acres in the study area and occur primarily in the vicinity of Berlin (Table II-19).

Residential. Residential uses occupy 7,042 acres of the study area and include low and medium density single-family homes and mobile homes (Table II-19). Multi-family development which is sufficiently extensive for tabulation is limited to the portion of Ocean City classified as strip development. Low density single-unit residential uses occupy 5,570 acres in scattered portions of Ocean City and concentrate in four general areas of the mainland: Ocean Pines, West Ocean City, the vicinity of Berlin, and the headwaters of Grey's Creek north of St. Martin Neck (Figure II-11). Medium density single-unit residential uses occupy 1,126 acres and occur primarily along the bay side of southern Ocean City and in the West Ocean City and Berlin areas. One small parcel of medium density single-unit residential use occurs on the bay side of upper Sinepuxent Neck. Mobile homes occupy 346 acres and occur in relatively

small, scattered subdivisions in three general areas: along the Route 50 corridor, in northern Ocean City, and on upper Sinepuxent Neck.

Approximately 5,100 second-homes were identified in Worcester County in 1970 by Morton Hoffman and Company (1974) (Table II-20). These homes were equivalent to approximately 37 percent of the total housing (primary and second homes) in the County. The number of second homes in the County doubled between 1970 and 1974, and this rate of increase was probably much greater than the increase in permanent residences. The major change in the character of second home development in Worcester County from 1970-1974 occurred as a result of the rapid increase in condominiums in Ocean City. More than 6,000 units were added during this period. Most of these units were front highrises. Ocean Pines, a major planned community, added 470 new second homes to the County. Enclaves of 20 or more second homes and mobile home parks also increased from 1970-1974. Scattered sites declined slightly. This was probably due to a tendency for most new homes to be developed in existing communities and also to the normal attrition of units due to age.

Table II-20. Second Home Units by Character of Development for Worcester County. Estimated 1970 and 1974.
[Source: Morton Hoffman and Company, (1974) p. 77].

	1970		1974	
	Number	Percent	Number	Percent
Second Home Development (Ocean Pines)	0	-	470	3.9
Condominium Development	590	11.6	6,650	54.5
Enclaves of 20 or More Units	395	7.7	470	3.9
Mobile Home Parks	1,205	23.7	1,810	14.8
Scattered Sites	<u>2,901</u>	<u>57.0</u>	<u>2,800</u>	<u>22.9</u>
TOTAL	5,091	100.0	12,200	100.0

3. Economy

Tourism, agriculture, and commercial fishing are the major components of the North Central Ocean Basin's economy. The Basin differs from most of Worcester County because tourism has replaced agriculture as the most significant economic force in the Basin in the vicinity of Berlin and the northwestern quadrant (St. Martin). This economic dicotomy is reflected in the data summarized in Table II-21.

Table II-21. Summary of Economic Data for All Families in Worcester County and the Three Election Districts Containing the North Central Ocean Basin. [Source: MDSP (1974)].

	<u>Worcester County</u>	<u>Berlin</u>	<u>St. Martin</u>	<u>Ocean City</u>
Number of Families	6274	1592	402	991
Average Family Size	3.5	3.6	3.1	3.2
Median Family Income	\$7386	\$7728	\$6231	\$8267
Families Below Poverty Level	1079	279	87	135
Percent of Total Families	17.2	17.5	21.6	13.6
Family Incomes				
Percent less than \$ 4,000	24.3	20.9	27.9	22.3
Percent greater than \$10,000	32.3	32.8	27.4	39.2
Percent greater than \$15,000	12.0	10.2	15.2	23.7

The three principal components of the North Central Ocean Basin economy, tourism, agriculture, and commercial fishing will be affected primarily or secondarily by the applicant's proposed project.

- The resort industry is Worcester County's principal economic resource. The development of this industry is related to the County's proximity to the Atlantic Ocean. Estimates of the monetary value of tourism and resort activities to the Worcester County economy vary substantially. COE (1976) estimated that Worcester County receives approximately \$31 million annually from tourism. However, a 1966 survey of overnight visitors and lodging managers in Ocean City cited by the Corps (1976), estimated that the annual commercial contribution to the County's economy from tourism and resort activities approached \$68 million. These revenues do not include sales, real estate, and other taxes.

In addition to the direct commercial value of tourism and resort activities, Worcester County obtains revenues generated from secondary sources such as labor and materials used in the construction of recreational homes (COE, 1976). Revenues also accrue from property and deed recording taxes whenever recreational property is sold. Summer employment also generates additional revenues and commercial activities.

The recreational, or vacation home industry in Worcester County has experienced a substantial growth in the past few years. From 1970 to 1974, the number of vacation homes in the County increased from 5,477 to 12,620 (COE, 1976). This expansion in the number of vacation homes is attributable to the increasing affluence of the nearby large metropolitan areas of Philadelphia, Baltimore and Washington, D.C. In addition, improved access resulting from the construction of the second Chesapeake Bay bridge and increasing amounts of leisure time have resulted in a general expansion of resort and recreational home development throughout the Eastern Shore, but particularly in Worcester County (COE, 1976).

Significant economic benefits are also generated by resort-related retail sales. Of a total of \$19.8 million spent in Worcester County during 1973 for food and beverages, \$12.4 million, or 65 percent, was attributable to tourists and visitors (COE, 1976). According to the Ocean City Comprehensive Plan, the commercial sales made by visitors are much higher. The Plan estimates that tourist-related retail sales in Worcester County in 1966 were approximately \$24.8 million for lodging, \$27.0 million for food, and \$16.0 million for gasoline and miscellaneous expenditures (COE, 1976).

- Agricultural production of corn, soybeans and broilers is significant in Worcester County. However, agriculture has been a declining source of income to County residents in recent years while trade and service sectors have become more important.

Agricultural sales in Worcester County during 1969 were approximately \$33 million (COE, 1976). Approximately 78 percent (\$25.5 million) of these sales was attributed to poultry and poultry products. Livestock and livestock products accounted for \$1.9 million or approximately 5 percent of the County's sales. Feed crops

comprised about 13 percent of Worcester County's total farm sales. Vegetables, fruits, and forest products contributed approximately \$1.3 million or about 4 percent of total sales. Since most of the feed crops are used to feed chickens, poultry production accounts for approximately 90 percent of all the agricultural sales in Worcester County.

The number of farms has been declining steadily in Worcester County (COE, 1976). The 615 farms in the County in 1974 were approximately 52 percent of the number in 1950. Although, total farm acreage in the County declined from 139,755 acres in 1964 to 110,881 acres in 1974, the average farm size increased from 169.4 to 180.3 acres during the same period. Part of the reason for these reductions is that an increasing amount of farm land is being used for retirement and resort community development. The North Central Ocean Basin currently contains approximately 24,300 acres of agricultural land (Section II-B-2).

- Commercial fishing is a relatively small but important industry in the North Central Ocean Basin (Table II-22). A steady supply of various finfish and shellfish in the area and proximity to markets, has attracted a local fishing fleet and associated support facilities (COE, 1976). However, because of fluctuations in the quality and size of the local fish and shellfish populations in comparison to competing areas, the size of the commercial fishing fleet and associated economic benefits to the local area are difficult to assess.

Oysters have traditionally been an important seafood product in Chincoteague Bay (COE, 1976). The natural oyster population has fluctuated in the past due to changing salinity in the bay and the presence of disease and predators. The existing oyster industry is primarily based on supplementing the existing stock through private planting of imported oysters. Most planting occurs in the Southern portion of Chincoteague Bay near Taylor Landing, George Island Landing, and Scott Landing (COE, 1976). Although these areas are beyond the limits of the North Central Ocean Basin, water quality in Chincoteague Bay is influenced by point and nonpoint source discharges in the Newport and Sinepuxent Bay drainage basins.

Clams are currently the most important fishery product in terms of monetary value and size of catch. Hard clams are harvested by commercial clammers based principally at Public Landing, Tanhouse Creek, Taylor Landing, Greenbackville, George Island Landing, Ocean City

Table II-22. Weight and Value of Fish and Shellfish Harvested in the Coastal Bays of the North Central Ocean Basin [Source: Bill Bray, NMFS (1977) Personal Communication].

ASSAWOMAN BAY

<u>Species</u>	<u>1973</u>	<u>1974</u>
Total	1,500 lbs (\$217)	3,800 lbs (\$2,097)
Hard Clams	None	2,900 lbs (\$1,984)

ISLE OF WIGHT BAY

Total	15,600 lbs (\$3,986)	9,800 lbs (\$3,992)
Hard Clam	2,900 lbs (\$1,946)	5,100 lbs (\$3,410)
Bluefish	3,300 lbs	2,300 lbs
Sea Trout	4,000 lbs	1,900 lbs
Spot	2,300 lbs	
Black Mullet	1,400 lbs	
Striped Bass	1,000 lbs	

SINEPUXENT BAY

Total	6,300 lbs (\$ 930)	18,900 lbs (\$6,938)
Hard Clam	600 lbs (\$ 428)	7,900 lbs (\$5,103)
White Perch	1,000 lbs	1,400 lbs
Bluefish	1,700 lbs	1,600 lbs
Menhaden	2,600 lbs	3,400 lbs
Striped Bass	300 lbs	2,800 lbs
Sea Trout	---	1,200 lbs

and Chincoteague. Hard clams are harvested mainly from shallow, coastal bays in the region, and surf clams are harvested offshore from areas near Assateague Island. The commercial importance of clams has increased in recent years principally because of the legalization of hydraulic dredging in October 1967. Limits on the size of the harvest are primarily due to the market price of clams, predation, and weather (Boynton, 1970).

Blue crabs are harvested in the area by commercial crabbers operating from many landings and towns along the western shore of Chincoteague and Sinepuxent Bays (COE, 1976). Most crabs are shipped to processors near the Chesapeake Bay, but some are processed at an establishment at George Island Landing. The value and size of the commercial crab harvest is variable, and depends on the quality and quantity of the local crab population in relation to populations in competing crabbing areas.

Finfish, principally fluke, sea bass, and striped bass, are caught in the coastal bays and in the Atlantic Ocean. Most commercial fishing now occurs in the ocean (COE, 1976). The monetary value of the finfish harvest is relatively small in comparison to the total shellfish harvest. The mix of fish species and the size and use of the harvest has varied substantially over the years, and has depended on factors such as market demand, habitat conditions, disease, and predators.

Although finfish and shellfish are harvested from the coastal bays of the North Central Ocean Basin (Bray, 1977, Personal Communication) data in Table II-23 indicate that this harvest is a minor component of the total harvest.

Table II-23. FISHERY HARVEST FOR WORCESTER COUNTY, MARYLAND. [Source: COE (1976)].

Year	OYSTERS		CRABS		CLAMS		FINFISH	
	Mone- tary Value (\$)	Weight (lbs)	Mone- tary Value (\$)	Weight (lbs)	Mone- tary Value (\$)	Weight (lbs)	Mone- tary Value (\$)	Weight (lbs)
1960	419,000	371,000	29,000	513,000	113,000	603,000	267,000	3,177,000
1961	406,000	359,000	11,000	225,000	Data not available			
1962	310,000	214,000	15,000	220,000	180,000	448,000	276,000	4,429,000
1963	292,000	217,000	13,000	206,000	246,000	532,000	514,000	8,651,000
1964	379,000	246,000	18,000	243,000	146,000	313,000	564,000	14,532,000
1965	433,000	282,000	89,000	844,000	118,000	449,000	442,000	15,791,000
1966	709,000	420,000	10,000	147,000	87,000	210,000	305,000	15,203,000
1967	385,000	210,000	19,000	218,000	246,000	1,420,000	350,000	7,997,000
1968	469,000	220,000	13,000	119,000	803,000	5,182,000	233,000	1,362,000
1969	418,000	227,000	15,000	194,000	1,337,000	7,889,000	190,000	1,195,000
1970	310,000	172,000	20,000	323,000	1,762,000	14,203,000	271,000	1,503,000
1971	296,000	158,000	35,000	322,000	1,165,000	8,072,000	232,000	1,084,000
1972	479,000	255,000	57,000	482,000	1,237,000	7,503,000	285,000	1,208,000
1973	486,000	255,000	89,000	404,000	1,201,000	1,201,000	387,000	1,699,000

4. Public Services

Public services are facilities that should be located in an area to serve and be used by the residents. These services must be evaluated in terms of their capacity to properly accommodate the number of persons they must serve and their accessibility (time and distance) to that population. The principal public services in the North Central Ocean Basin area:

- Education
- Health Care
- Water Supply & Sewerage
- Solid Waste Disposal
- Police Protection
- Fire Protection
- Recreation
- Transportation

Health Services. Thirteen physicians and 11 dentists currently practice in Worcester County. Worcester County has no hospitals. Patients from the County may utilize the Peninsula General Hospital in Salisbury, Maryland, which is approximately 30 miles west of Ocean City.

The Worcester County Public Health Department has offices in Berlin, Snow Hill and Pocomoke City. The staff consists of one part-time health officer, seven public health nurses, three sanitarians, one environmental health aide, and three clerks. A medical-nursing division is also provided in the County. Services offered include immunization, maternal and child health, family planning, handicapped services, general disease control, communicable disease research and mental health. An environmental health division of the Public Health Department, located in Snow Hill, is responsible for the sanitary supervision of sewage disposal, water supplies, food establishments, swimming pools, nursing homes, foster homes, solid waste disposal and subdivisions (COE, 1976).

The growing permanent and visitor population has strained the capacity of the City's health service system. The prospect of rapid future growth threatens to strain the existing system (Flagle and Goldschmidt, 1974). The small permanent population and relatively short busy seasons

have precluded the building of a large hospital or major medical center in Ocean City.

Ocean City has two medical facilities, the 10th Street clinic and the 41st Street clinic. The 10th Street clinic is open 24 hours per day, 7 days per week during the summer and accommodates 80 percent of all patients treated in Ocean City. The 41st Street clinic is open for approximately six hours a day, but treats 20 percent of all patients. The Cape Isle of Wight Medical Center will open this summer and will have capacity to treat minor medical problems and provide emergency service.

Education. The public school system in Worcester County is sufficient to meet the present needs of the resident population (COE, 1976). Worcester County has experienced a slight decline in school enrollment during the past few years. The present student/teacher ration is approximately 20:1 for kindergarten and the first grade; the ratio is slightly higher, 25:1, for the remaining grades up through the twelfth. The annual per pupil expenditure during the 1974-1975 school year was approximately \$1,300. If currently planned building modernizations and minor additions are implemented and considering recent enrollment trends (COE, 1976), the system should be more than adequate for the near future.

Transportation. Transportation facilities in Worcester County include a network of public roads, railways, small boat harbors and dock facilities, and an airport.

The Worcester County highway and street system is generally in good condition and has the ability to accommodate additional traffic flow (COE, 1976). The County has approximately 749 miles of road; of these, 479 miles are county roads, 193 miles are state roads, and 77 miles are municipal streets.

Of all the roads in Worcester County, none is more heavily traveled than U.S. Route 50. In 1963 the average daily vehicle traffic on Route 50 was 4,404 vehicles. By 1973, average daily traffic on the road had increased to 10,616 vehicles. During the summer the daily traffic volume changes substantially. In 1973 the average daily summer traffic was almost 20,000 vehicles per day (COE, 1976).

Approximately one-third of the land area in Ocean City is currently devoted to the automobile for streets and parking lots (Urban Pathfinders, 1976). The City's street

system, even with planned improvements, cannot support more than a 10 percent increase in population growth. Beyond that increase traffic congestion is projected to stifle growth.

Large increases in Worcester County's traffic have occurred due to the construction of the Chesapeake Bay Bridge in 1952 and the opening of a second span in 1973. The first bridge facility made the Ocean City area more accessible by private car or public bus to both Baltimore and Washington, D.C. The second bridge was constructed to alleviate congestion created by the increasing volume of traffic between the metropolitan areas and the Eastern Shore. Travel time between these areas on summer weekends has increased from 3 to 4 hours to 6 or 7 hours. Congestion occurs along U.S. Route 50 at Vienna, Cambridge, and Kent Narrows and on Maryland Route 404 at Denton (Figure II-12). The Mayor of Ocean City recently requested a meeting with the Governor of Maryland and State Highway Administration officials. The State proposed that alleviating congestion at these points would possibly incur costs as great as \$200 million and that construction of the projects would not occur before 1982. The Mayor has suggested a public information program concerning alternate traffic routes as the first step in a program to facilitate travel to and from Ocean City.

Worcester County is served by the Continental Trailways Bus Company which provides daily service to Washington, D. C., Baltimore, and Philadelphia. Additional scheduling and service is provided by the Greyhound Lines, Inc. during summer recreation months. The only local bus service is provided by Ocean City which operates small 12-seat "mini-buses" during the summer on a route from the Ocean City inlet to the Maryland-Delaware boundaries.

Worcester County receives rail service from the Penn-Central Railroad, but that service does not include passenger transportation.

Worcester County has one public airport (the Ocean City Airport) which is located on Sinepuxent Neck south of West Ocean City. There is no scheduled service to the airport. Future plans for the Ocean City Airport include the addition of a north-south runway to complement the existing east-west runway (FAA, 1976). However, the Salisbury-Wicomico County Airport in Salisbury provides regularly scheduled service to both Baltimore/Washington International Airport and Washington National Airport (COE, 1976).

FIGURE II-12. MAJOR TRAFFIC ROUTES AND POINTS OF CONGESTION BETWEEN BALTIMORE AND OCEAN CITY.
[SOURCE: Baltimore Sun (June 3, 1977)].



Only Way(s) To Go

The above map shows the three primary ways to drive to Ocean City. The biggest traffic problems so far this year have been at the Kent Narrows drawbridge and just west of Cambridge along Route 50 and in the Denton area on Route 404.

Police Protection. In Worcester County, police protection is provided by state, county and municipal governments. The Maryland State Police have a barracks in Salisbury and patrol U.S. Routes 50, 13 and 113 and other roads. A second state police barracks is currently being constructed in the Town of Berlin and should be ready for operation later this year. This facility will provide year-round services.

The Worcester County Sheriff's Department is located at the county jail in Snow Hill. The department has a full-time staff of 12 men and utilizes seven radio-equipped cars for patrolling the County.

Additional public protection is provided to Worcester County residents and others using facilities and craft offshore by the U.S. Coast Guard Life Boat Station located in Ocean City. In addition, aircraft from the Patuxent Naval Air Station are available for additional search and rescue missions.

During the summer, additional police protection is provided in Ocean City. Approximately 90 people are added to the Ocean City police force and 130 people are added to the beach patrol.

Fire and Rescue. Five volunteer fire companies are located within the North Central Ocean Basin: Ocean Pines, Berlin, Showell, Bishopville, and Ocean City (COE, 1976). The companies are served by approximately 270 volunteers and have available 32 pieces of equipment.

Provision of adequate ambulance service is difficult because of the large number of weekend visitors at Ocean City on a normal summer weekend. If a large number of accidents were to occur in the Ocean City area in a short time period, or if a major catastrophe was to occur, local volunteers would be quickly over-whelmed (Urban Pathfinders, 1974). The existing communications system is capable of calling for all of the ambulance units in the County and in adjacent areas such as Salisbury to respond in a reasonable time.

Solid Waste Disposal. Worcester County operates seven land disposal sites. Collectively these sites serve 75 percent of Worcester County residents and all of Ocean City's residents (Roy F. Weston, 1974). The sites have many similarities. The maximum depth to water table is six feet, and several sites are located on marsh lands. Uncontrolled burning is permitted and refuse is covered only periodically. No disposal fee is required, and the attendants do not keep operating records. In addition, access is not adequately controlled. Most of the sites have very little, if any, estimated life remaining (Roy F. Weston, 1974). The summer vacation population generates more solid waste than all of the permanent residences and establishments of Worcester County generate during an entire year.

The County will close its existing seven sites in 3 to 5 years and maintain two large landfills (COE, 1976). To implement this plan the County recently purchased approximately

175 acres near the Town of Berlin and approximately 200 acres north of Pocomoke City for future landfill sites. According to county planners, adequate facilities are presently available and should continue to be available for future population growth (COE, 1976).

Water-Based Recreation. Due to the North Central Ocean Basin's proximity to the coastal bays and to the Atlantic Ocean, water-based recreation is of major importance in the area. Protected ocean beaches suitable for swimming are located at Ocean City, and the Assateague Island National Seashore. These ocean beaches and their associated amenities, such as the "boardwalk" in Ocean City, are the major tourist attractions in the region.

Recreational boating is important in the area because of the large areas of protected inland waters and the access to the Atlantic Ocean provided by the Ocean City Inlet. The number of outings by recreational boat owners on the intra-coastal waters in Worcester County (August 1969 - July 1970) was 6,021 for fishing, 1,255 for water skiing, and 7,700 for pleasure cruising (COE, 1976). In Worcester County, the recreational boat ownership ratio is about 38 boats per 1,000 population, and a total ownership ration of 45 boats per 1,000 population.

Boating congestion has become a significant problem in the Ocean City area. Approximately 41,300 boat launchings occurred in the coastal bays and Ocean City inlet during 1974 (Roy Mann, 1974). Approximately 57 percent of these launchings occurred in the inlet area (Table II-24). The results of the survey, which did not include out-of-state boats, indicated that the Ocean City Inlet area has minimal boating capacity available.

Land-Based Recreation. Land-based recreational activities consist mainly of camping, fishing, bicycling, hiking, hunting, golfing, and tennis. Most privately-owned recreational facilities are located in or near Ocean City, and are designed primarily to accommodate the seasonal influx of tourists (COE, 1976). A number of publicly-owned recreational facilities in Worcester County are used year-round by both the permanent and seasonal residents. Two major public recreation areas in the basin are Assateague Island National Seashore and Wildlife Refuge and Shad Landing State Park. Activities at these parks include camping, fishing, canoeing, hiking, sightseeing, picnicking, and swimming. A number of smaller facilities in the region provide a limited number of recreational facilities in the form

Table II-24. Recreational Boating Characteristics of the North Central Ocean Basin. [Source: Roy Mann (1974)].

	<u>Estimated Total Launchings</u>	<u>Activity Total Number of Boats on a Peak Sunday</u>	<u>Capacity Optimum Number of Operating Boats</u>	<u>Activity to Capacity Ratio</u>	<u>Reserve Capacity</u>
Sinepuxent Bay	5,513	90	164	0.55	Low
Isle of Wight Bay/ Assawoman Bay	3,676 }	719	924	0.78	Low
Ocean City Inlet	13,432				
Newport Bay/ Chincoteague Bay	<u>8,653</u>	447	6,015	0.07	High
TOTAL	41,274				

of fishing piers, picnic areas, sport fields, playgrounds, horseback riding and hiking trails, swimming pools and bicycling.

The beach at Ocean City is one of the most important recreational resources in the North Central Ocean Basin. Continued recreational development of Ocean City will depend upon the continued attractiveness of the beach.

The policy of Maryland's Coastal Zone Management Program is to "assure adequate public access and use of beach areas" and "to promote increased recreational opportunities in shoreland areas and increased public access to tidal waters in a manner which protects the quality of coastal resources and protects public health and safety."

In consideration of potential beach overuse, various local, state and national studies have recommended density limits for beach use (Table II-25). The Maryland Outdoor Recreation and Open Space Plan (1974) provides some basis for limiting people in recreation areas by establishing maximum numbers per unit area for various activities including beach use. The Army Corps of Engineers has developed density standards for use in determining benefits and costs of beach erosion control projects.

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Table II-25. Beach Use Densities Established by Various State and National Agencies.

<u>Agency/Plan</u>	<u>Persons/Acre/Day</u>	<u>Density</u>		<u>Ocean City Beach Carrying Capacity (People per day)</u>
		<u>Square Feet Per Person</u>	<u>Turnover Rate</u>	
1. Md. Outdoor Recreation and Open Space Plan*	290	150	None Indicated	62,100
2. U.S. Army Corps of Engineers**	1,162	75	2 shifts, 4 hours each	248,700
3. Soil Conservation Service**	438-871	50-100	None Indicated	93,300-186,400
4. Bureau of Outdoor Recreation**	871	75	1.5 shifts	186,400
5. Texas Comprehensive Outdoor Recreation Plan**	145	300	None Indicated	31,000

* Source: Maryland Department of State Planning, 1974.

** Source: U.S. Department of Interior, 1970.

Based upon these standards, the carrying capacity of the Ocean City beach ranges from 31,000 to 248,700 people/day (Table II-25). The standards applied are only recommended and do not constitute an official determination. However, any number of people beyond the maximum calculated carrying capacity of 248,700 people/day could significantly reduce the quality of the recreational experience. When this number of people is reached a "spillover" effect may take place and be manifested by greater demands on Assateague Island and the Delaware beaches. The Worcester County Comprehensive Plan includes a discussion of using the northern portion of Assateague Island as a recreational beach to relieve crowding at Ocean City.

Several projections prepared for Ocean City indicate that peak populations will exceed the calculated carrying capacity. It is difficult to determine at what population "overcrowding" will become a psychological/social deterrent to beach use.

Water Supply. All water supplies in the North Central Ocean Basin are currently withdrawn from groundwater, and all future supplies are expected to be provided by the same source. Because of their salinity, no surface waters are available as a potable water supply in the area.

The raw water supply for Ocean City is withdrawn from the Ocean City aquifer and the Manokin aquifer. The maximum withdrawal from these aquifers for Ocean City's water supply occurred on August 7, 1976 when 8.66 million gallons were required to serve a peak weekend daily population which approached 200,000 persons (Whitman, Requardt & Associates, 1977). The aquifers have sufficient capacity to serve at least 300,000 people with a daily withdrawal of 15 million gallons.

Ocean City presently has four water treatment plants, and each plant has its own well field which supplies raw water. Three treatment plants - South Plant, 15th Street Plant and 44th Street Plant - all obtain raw water from the Ocean City aquifer. Gorman Avenue Plant withdraws water from the deeper Manokin aquifer. Chloride concentrations recently began to increase in the Manokin aquifer. Recent tests have revealed chloride concentrations of 115 ppm at the Gorman Avenue Plant. These concentrations are substantially greater than the 880 ppm in raw water from the well field at the 44th Street Plant and approximately 40 ppm in the other plants. The maximum recommended concentration for potable water by EPA is 250 ppm. If the chlorides exceed the recommended

concentration the well field would have to be abandoned because chlorides cannot be removed or reduced by economical processes.

Because potable water is available from one or more aquifers throughout Worcester County, no regional water systems have been planned or developed. Most of the potable water withdrawn in eastern Worcester County currently comes from the Pleistocene aquifer. Some additional supply is provided by the deeper Pocomoke and Manokin aquifers. Pleistocene deposits are potentially among the most productive aquifers in Maryland and are capable of extensive development (MSDP, 1969). However, salt water has penetrated the aquifers in areas near the ocean and tidal marshes. Water at depths greater than 50 feet is generally free of salt.

Sewerage. The existing wastewater collection and treatment facilities in the North Central Ocean Basin were described in Section I,B of this EIS. WRA (1976) identified sewerage facilities as a major factor restricting growth and development in the Basin.

5. Archaeological and Historical Sites

According to the Maryland Historical Trust [MHT] (1977), the following historical sites have been entered on the National Register of Historic Places. Numbers in parentheses correspond to those in Figure II-13.

- (1) Mason Dixon Line Marker
- (6) Caleb's Discovery
- (8) Buckingham Site
- (17) Sandy Point Site
- (18) Genesar
- (19) Burley Manor

St. Martin's Episcopal Church (3), and Henry's Gorge (13) have been approved for nomination to the National Register by the Maryland State Review Board (MHT, 1977, Personal Communication). According to MHT the following sites are probably eligible for entry on the National Register.

- (1) Fenwick Island Lighthouse
(same location as Mason Dixon Line Marker)
- (2) Bishop House
- (4) Gillis Store
- (5) Evan House
- (7) Merry Sherwood
- (9) Charles Ewell House
- (10) Golden Quarter
- (11) Fassitt House
- (12) George Purnell House
- (14) Old Lime Kiln
- (15) Newport Farmhouse
- (16) William's Grove

The Worcester County inventory is not complete, especially for Berlin and Ocean City. EPA has contacted the State Archaeologist for the identification and location of possible archaeological sites, but had not received a reply at the time this Draft EIS was printed.

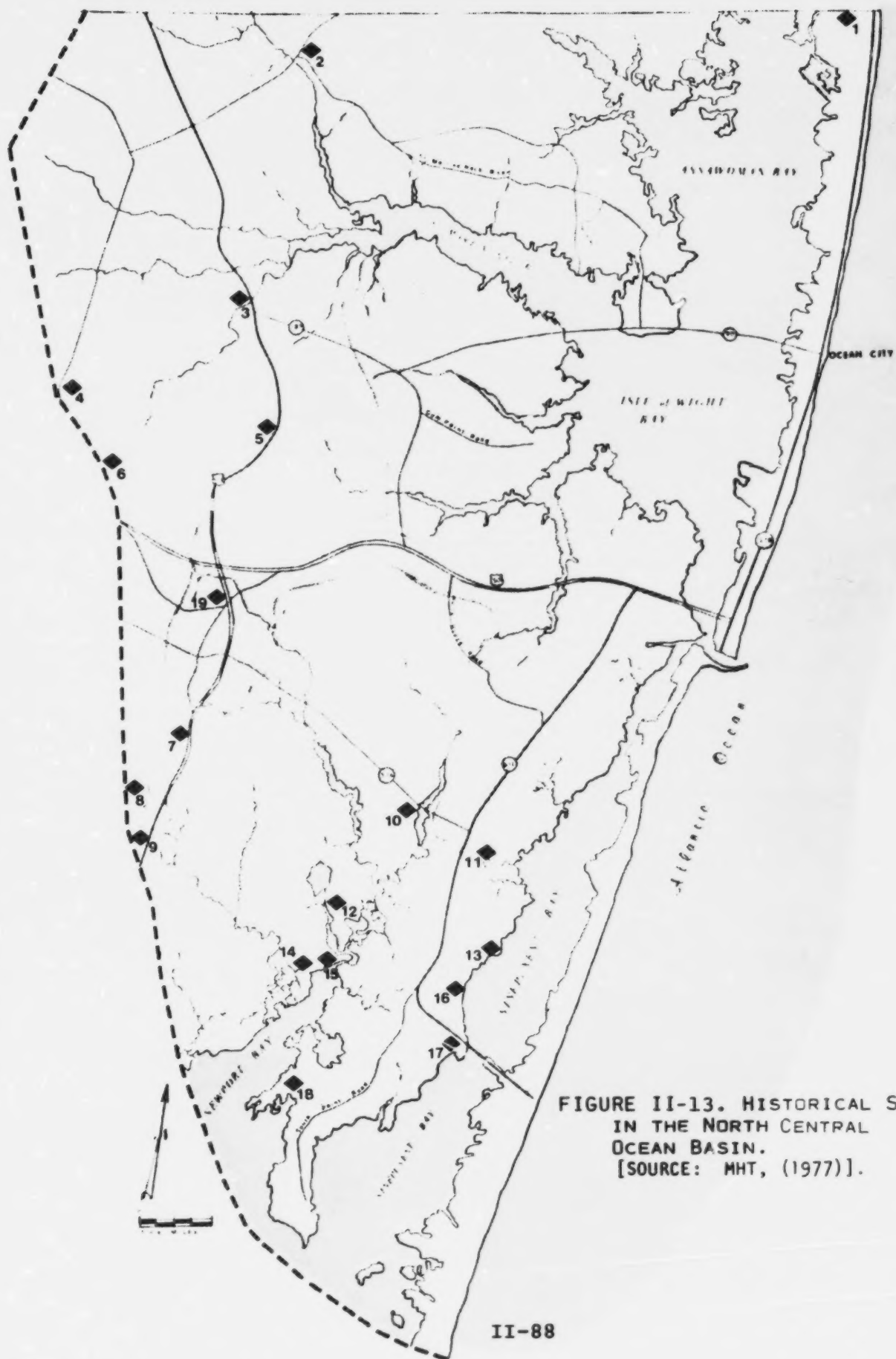


FIGURE II-13. HISTORICAL SITES
IN THE NORTH CENTRAL
OCEAN BASIN.
[SOURCE: MHT, (1977)].

6. Aesthetics

The aesthetic features of the North Central Ocean Basin are varied and contrasting and are a major factor in attracting people to the area. The principal aesthetic features of the region are the Atlantic Ocean, the inland bays and estuaries, and their associated shorelines. In spite of its intense recreational use, the region is relatively unspoiled and contains expanses of natural areas, clean air, and areas of rural tranquility.

The physical presence of the ocean and its effect on landforms is impressive. The 37-mile long Assateague Island National Seashore was established in part to preserve the aesthetic enjoyment associated with an ocean beach. Relatively quiet inland bays are separated from the ocean by thin barrier islands. The waters of the bays and estuaries are bordered by extensive and fragile marshes. The ocean surf provides a dramatic contrast to the tranquility of the bays and marshes. Both of these aesthetic features are attractive to residents and visitors to the area.

The marshes in and around the bays and estuaries are excellent habitat for a variety of wildlife that add to the aesthetic and recreational value of the region. Many people are attracted to the marshlands to enjoy birdwatching and view other animals in their natural habitat. Other natural areas in the basin also provide opportunities to observe wildlife as well as to contemplate the natural features of the coastal plain.

In addition, to the area's natural features, the recently developed "skyline" of Ocean City is impressive. Whether the viewer is favorably or unfavorably impressed is a matter of personal taste. The recently constructed highrise condominiums are visible for several miles because of the relatively flat terrain west of Ocean City. These buildings provide a dramatic contrast to the immediately surrounding marshes, bays, and ocean.

C. ENVIRONMENTALLY SENSITIVE AREAS

Preserving natural processes and areas of valuable natural resources is an important consideration during the development of an area. Environmentally sensitive areas are fragile features which are not suitable for certain uses without direct and/or indirect social, economic and environmental costs. Identification of these areas is the first step in satisfactorily resolving the inherent man-nature conflicts in a developing area.

1. Surface Waters

Several rivers and surface water areas in the study area have been closed to shellfishing by the DHMH because of high coliform bacteria counts, or as precautionary closure zones around point source discharges.

The following contaminated bodies of water or closure zones are located within the North Central Ocean Basin (Figure II-14):

- Atlantic Ocean - all the waters of the Atlantic Ocean from 55th Street to 73rd Street and extending 1 1/2 miles out to sea.
- St. Martin River - all waters of the river upstream of a line extending from Cedar Point to Poplar Point.
- Herring and Turville Creeks

The North Central Ocean Basin contains four principal tidal bays: Newport, Sinepuxent, Isle of Wight, and Assawoman. Several major tributaries including the St. Martin River, Greys, Turville, Herring and Trappe Creeks and numerous small streams discharge into the bays. The bays occupy more than 60,000 acres, are shallow, and have relatively long flushing times. In recognition of their sensitivity, WRA (1966) proposed that the waste assimilation capacity of the bays is minimal and formulated a policy which permits no new effluent discharges to the bays and proposes to remove all existing discharges.

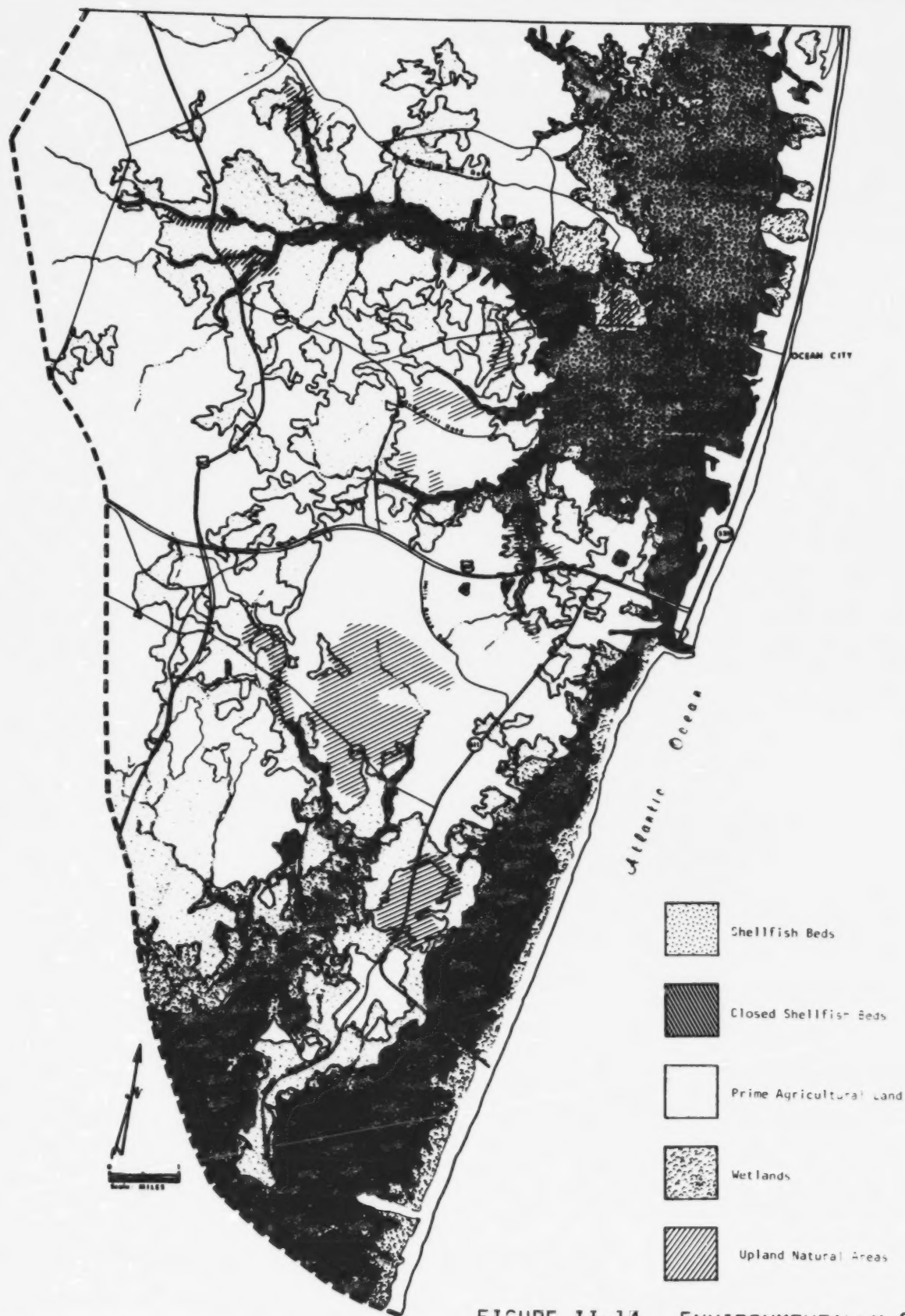


FIGURE II-14 ENVIRONMENTALLY SENSITIVE AREAS OF THE NORTH CENTRAL OCEAN BASIN.

2. Flood Plains

Flood plains identified by the U.S. Department of Housing and Urban Development (HUD) occupy a significant portion of the North Central Ocean Basin (Figure II-15). The effects of flooding in the Basin are exacerbated by the limited topographic relief, seasonal high water table, and tidal flow in most streams. All three municipalities with jurisdiction in the Basin have, or are in the process of revising, zoning and building codes to control development in the 100-year flood plain. Most of Ocean City, including the site of the existing sewage treatment plant, is a special flood hazard area (Zone A6). The elevation of the 100-year flood is 9 feet above mean sea level. The higher areas of Ocean City have been designated as "moderate" and "minimal" flood hazard areas. Special flood hazard areas on the mainland include substantial portions of West Ocean City, Ocean Pines, Upper Sinepuxent Neck, and the eastern section of the Route 50 corridor.

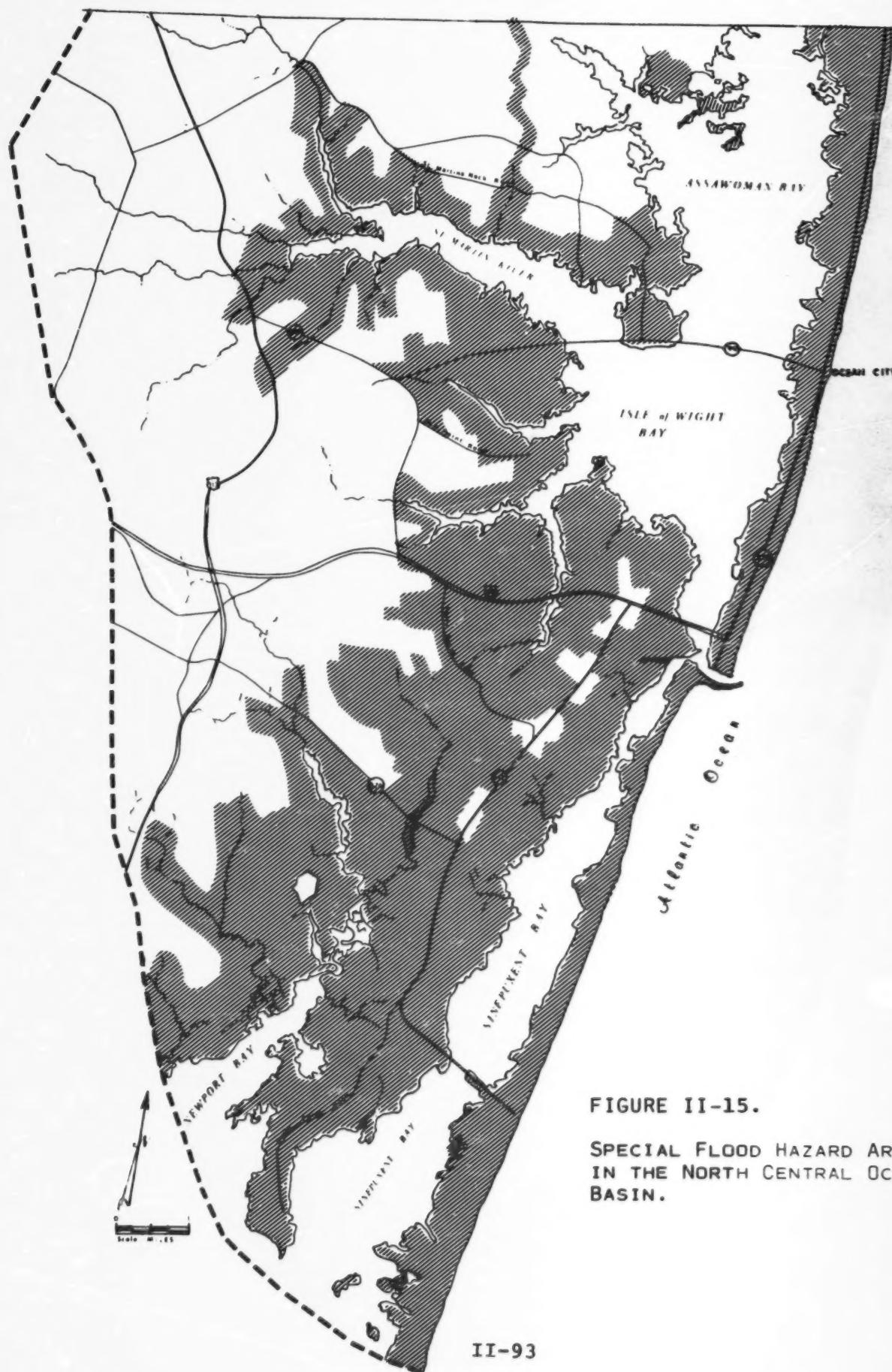
3. Marshes and Wetlands

Maryland's wetlands have been classified into two categories - state-owned and privately-owned. State-owned wetlands include all lands under the navigable waters of the State below the mean high tide, which are affected by the regular rise and fall of the tide. Private wetlands include all lands not considered state wetlands which border on or lie beneath tidal action and which support aquatic growth. Extensive areas which meet the State's definition are located in the study area (Figure II-14).

4. Groundwater/Aquifer Recharge Areas

All potable water in the Basin is withdrawn from groundwater. Fresh groundwater in the study area is restricted to the uppermost 450 feet of coastal plain sediments (Weigle, 1974), and occurs in the Pleistocene, Pocomoke, Ocean City and Manokin aquifers.

- Pleistocene deposits are potentially among the most productive aquifers in Maryland and are capable of extensive development (MSDP, 1969). However, salt water has penetrated the aquifer in areas near the Ocean and tidal marshes. The aquifer recharges directly from precipitation on the Basin.



- The Pocomoke aquifer is capable of producing yields ranging from 500 to 2,000 gpm. Recharge normally occurs by direct percolation from overlying Pleistocene deposits. A portion of the recharge area of this aquifer occurs in the northwest portion of the Basin (Figure II-2). Salt water intrusion is not a problem in the aquifer but indirect salt water intrusion could occur at points where the upper confining bed is absent or inefficient or where the overlying Pleistocene aquifer is poorly sealed from adjacent salt water.
- The Ocean City-Manokin aquifers are the principal water supplies for Ocean City. The Manokin aquifer is recharged directly from overlying saturated Pleistocene sands and gravels in western Wicomico and southeastern Worcester Counties (MSPD, 1969). Salt water intrusion is restricted to the basal section of the Manokin aquifer. Weigle (1974) proposed that the danger of salt water intrusion into the Manokin aquifer will increase with increased withdrawals. No evidence of increasing salt water intrusion was present during a recent survey of the area.

5. Soils

SCS has defined prime agricultural land as "land which is best suited for producing food, feed, forage, fiber and oilseed crops." Soils in capability units I and II generally satisfy the requirements of prime agricultural land.

Approximately 13,121 acres of prime agricultural land occur in the North Central Ocean Basin. Approximately 2,244 acres of prime agricultural soil occur in the proposed service area. Significant areas of prime agricultural soils have already been developed in Ocean Pines and West Ocean City.

Agricultural land in Maryland is protected from development under the Use-Value Assessment Act, passed in 1956. Under this law, farm land is assessed taxation on the current use of the land rather than its value on the open market.

Numerous areas in the North Central Ocean Basin have been identified as having several restrictions for septic tank development. Soils in these areas are not suitable for septic disposal fields because of seasonal or fluctuating high water tables, flooding or ponding hazards, high sand content, and slow permeability.

6. Endangered Species

No plant species are presently listed as endangered by either Federal or Maryland State regulations (Taylor, 1977).

Peregrine Falcons, protected by Federal regulations, utilize Assateague Island for resting and feeding during spring and fall migration (Ward, 1977; Taylor, 1977). An active bald eagle nesting area, also protected by Federal regulations, is located within the planning area south of Berlin (Taylor, 1977).

7. Recreational and Open Space Areas

The Assateague Island National Seashore and State Park are the primary recreation/open space areas contained in the North Central Ocean Basin. The other major recreational area in the Basin is Ocean City.

8. Upland Natural Areas

Pursuant to the Coastal Zone Management Act of 1972, the State of Maryland has completed a Natural Areas Inventory for use in the "designation of areas of particular concern". Natural areas are defined by the state as "areas where, at present, natural processes predominate and are not significantly influenced by either deliberate manipulation or accidental interference by man." Seventeen potential natural upland areas have been delineated in the Basin by DNR (Figure II-14).

9. Historic and Archaeological Sites

The North Central Ocean Basin contains five sites which have been included in the National Historic Register. In addition, the State of Maryland Historical Trust has recognized many other sites as worthy of special concern (Figure II-9). Three sites of archaeological interest have been defined, and the entire study area is believed to contain many sites of archaeological value.

10. Barrier Dune/Beach Systems

Two barrier dune systems protect the mainland of Worcester County from most oceanic processes. Fenwick Island extends from the Maryland-Delaware boundary to Ocean City Inlet while Assateague Island extends south of the inlet and continues beyond the Maryland-Virginia boundary. Barrier dune systems are continuously subjected to atmospheric and oceanic induced stresses of varying intensities which constantly alter their locations, sizes, and physiographies.

Surveys of Assateague Island indicate a general erosion along the Maryland portion of the island at an average rate of three feet per year. However, the northern portion of Assateague Island is experiencing a much greater annual rate of erosion because of the jetties protecting the Ocean City Inlet.

SECTION III
STATUS OF COMPREHENSIVE PLANNING

The following section of this environmental impact statement contains a discussion of projected land uses and populations in the North Central Ocean Basin and the proposed sewer service area. The discussion includes a description of the planning agencies having jurisdiction in the area and their powers, responsibilities, and interactions. Population forecasts for the area are analyzed. Information developed in this discussion is incorporated into the analysis of the proposed project's environmental impact (Section IV) and the analysis of alternatives to the proposed project (Section V).

III. STATUS OF COMPREHENSIVE PLANNING

The following section of this EIS contains a discussion of the planning agencies having jurisdiction in the North Central Ocean Basin and their planning activities. In addition, projected population distributions and projected land use in the service area of the proposed wastewater treatment facilities are evaluated. The legal and planning mechanisms used by various jurisdictions in the study area and the effectiveness of these efforts to manage land use are also evaluated.

A. PLANNING AGENCIES AND ACTIVITIES

Article 66B of the Maryland Code grants to local jurisdictions the power to plan and zone (MDSP, 1975). In the North Central Ocean Basin, Worcester County, Ocean City, and Berlin exercise these powers through planning and zoning commissions, comprehensive plans, zoning laws, and subdivision regulations.

1. Worcester County

Worcester County is currently reviewing and revising its comprehensive plan and land use regulations. The new comprehensive plan has been completed and was adopted by the Worcester County Planning Commission in February, 1976. Approval by the Worcester County Commissioners is pending. Zoning and subdivision regulations are still being revised to reflect the goals and objectives of the plan.

By definition, the goals of the comprehensive plan are general and have been designed to guide the formulation of the more specific policy objectives and action recommendations which comprise the body of the plan. The principal goals of the plan include:

- Maintain growing economic benefit from Worcester County's natural resources while maintaining a harmonious land use pattern and safeguarding the County's environment for future generations.
- Expand Worcester County's economy to realize its employment, business, and commercial service opportunities.
- Provide the opportunity for all Worcester County residents to live in comfortable, safe, and affordable housing.
- Provide a complete system of economical public services which are responsive to the needs of Worcester County's year-round and seasonal residents.

- Provide for the safe and efficient movement of people and goods within Worcester County.
- Secure sufficient financial resources to maintain needed governmental programs.
- Encourage and maintain strong citizen participation in government.
- Maintain effective cooperation between the County and its municipalities for mutual benefit.

The Worcester County Comprehensive Plan begins with a "Development Philosophy" upon which many of the recommendations to implement the plan are based. This philosophy involves maintaining population growth, protecting the natural environment, and providing public services. The plan predicts very rapid growth in peak seasonal populations through the year 2000 and accepts this prediction by stating, "The county wishes to achieve its full population growth potential." The plan also identifies the importance of the natural environment as a "key element" in the county's growth potential, and recognizes the need to preserve the county's "restful forests" and "clean waters and beaches" in order to realize this potential. The importance of the county's agricultural base is also recognized. Adequate public services are also identified as critical factors for the continued growth of the county.

The plan recommends that the new zoning ordinance contain the following major concepts:

- high densities in areas planned for sewers,
- low densities in non-sewered areas,
- restrictions of highway strip development,
- zoning adequate land for commercial and industrial uses, and
- control of mobile homes

In addition, new subdivision regulations should include increased review of major subdivision projects in agricultural areas, and requirements that developers provide community services, designed to County standards, at their expense.

Revisions of the zoning ordinance have been drafted and are currently being reviewed. The County subdivision regulations are also being revised.

2. Ocean City

Ocean City's Comprehensive Plan was prepared by Harland, Bartholomew and Associates and was adopted in 1969. A complete review and revision of the plan is currently nearing completion. Substantial changes in the plan are expected. However, current zoning laws and maps and subdivision regulations will not be changed substantially after the new plan is adopted. Zoning maps in Ocean City have been revised annually since 1971.

The principal goal of the Ocean City Comprehensive Plan is the preservation and extension of recreational facilities accessible to all visitors. The objectives of the plan include:

- preservation and development of public beach for the entire length of the Town,
- provision of facilities to enhance automobile circulation,
- control of bayfront development to enhance accessibility and public use,
- provision of additional recreational facilities.

Other goals from the current plan are:

- prevention of overcrowding of land,
- extension of the business season, and
- general enhancement of the City's appearance.

3. Berlin

Berlin's Comprehensive Master Plan was written in 1966 and revised in 1974. The 1974 revision was adopted by the Council and Planning Commission in late 1974. Zoning and subdivision regulations now in effect were adopted in April, 1966 and April, 1967, respectively. None of these regulations is currently planned for revision.

Berlin's comprehensive plan does not identify specific goals which its recommendations are designed to attain. The plan's general "purpose" is to produce "an orderly, attractive, and efficient community that will conserve existing assets and investments while promoting the beneficial growth of business and industry and providing for the necessary public services and facilities." The plan contains two major recommendations:

- Berlin should plan for an increase in population of 40 percent during the next 20 years or less.
- Berlin should create such an attractive, agreeable and thoroughly convenient town that it will attract the maximum possible amount of business and industry, along with substantial residents, from the current growth along the ocean shore.

These recommendations indicate that the major goal of the plan is to completely satisfy Berlin's potential for population and economic growth. The plan also stresses coordination with Worcester County's plan. Other conclusions and recommendations of the plan include:

- Residential areas should be developed as cohesive, homogeneous neighborhood units separated by compatible nonresidential uses.
- Existing commercial areas are insufficient in relation to existing population levels; commercial areas should be increased from four percent of the current developed area to seven percent of the area planned for eventual development in 1985. The central business district should be improved to counteract competition from peripheral shopping centers.
- Industrial and transportation land uses occupy an appropriate proportion of the town's land (18 percent). Approximately 20 percent of the Town's area should be available for future industrial and transportation sites.
- Recreation and conservation areas are "seriously deficient." The current one percent of the Town's area devoted to recreational uses should be expanded to 13 percent in order to conform more closely to national standards. This recommendation, originally formulated in 1966, was retained in the 1974 revision and has been pursued through the establishment of a new park south of Tripoli Street.

B. LOCAL GROWTH MANAGEMENT CONTROLS

Two of the most important methods of implementing land use plans in the study area are zoning and subdivision ordinances. Other local growth management controls include Capital Improvement Programs, Minimum Lot Sizes for Septic Tanks, Regulation of Access to Sewers, and Open Space and Recreational Planning.

1. Zoning and Subdivision Ordinances

The policies contained in the adopted land use plan are implemented and enforced by zoning and subdivision ordinances. The text of the zoning ordinance translates the policies established in the plan into specific standards, requirements, and restrictions governing the development of each land use category. The zoning map transfers the general locations of land use on the land use map into specific locations and land use districts throughout the municipality. The development of each location is controlled by the appropriate regulations described in the text of the zoning ordinance. Land use controls implemented without the guiding policies of a land use plan may result in inconsistent regulation, development of incompatible uses within the same area, or fragmented development.

No regulation has been currently promulgated by EPA concerning conformance of zoning ordinances to comprehensive plans in order to receive municipal construction grants. However, when EPA concludes that the secondary effects of a project can reasonably be anticipated to contravene an environmental law or regulation, or a plan or standard required by an environmental law or regulation, the EPA Regional Administrator can withhold approval of a Step 2 or Step 3 construction grant until the applicant revises the plan, initiates steps to mitigate the adverse effects, or agrees to conditions in the grant requiring actions to minimize the effects (EPA, 1975). Secondary effects may be mitigated by a variety of actions, including, but not limited to:

- phasing and orderly extension of sewer service;
- project changes;
- improved land use planning;
- better coordination of planning among communities affected by the project;
- sewer use restrictions;
- modification or adoption of environmental programs or plans such as Air Quality Maintenance Plans;
- improved land management controls to protect water quality, such as sedimentation-erosion control and flood plain management.

EPA (1975) specified that an applicant should be required to demonstrate "good faith" and be clearly attempting to initiate adequate mitigative action before the grant is awarded.

Worcester County's present zoning ordinance and zoning map fail to correspond to the Comprehensive Plan.

- Many areas in the proposed sewer service areas are not zoned at the high densities proposed in the 1976 Comprehensive Plan. Much of the service area is zoned A-1 (agricultural).
- No zoning restriction currently exists to prevent strip development along Route 50. Most of this corridor is zoned as B-2 (general business).
- The Isle of Wight is currently zoned C-1 (conservation) although the Plan indicates that it will become a suburban land use area.

In 1965, Worcester County adopted its first Comprehensive Master Plan and Zoning Ordinance. One hundred applications for rezoning have been filed with the Planning Commission during the last ten years (Worcester County Planning Department, [WCPD], 1976). Sixty-seven requests have been approved by the County Commissioners. Through this process 7,358 acres of land in Worcester County have changed zoning classification. Of this total, the following acreages of once primarily rural undeveloped areas, were rezoned to other uses (WCPD, 1976).

- 524 acres were reclassified to Agricultural or Conservation Uses.
- 3,138 acres were reclassified to Rural or Urban Residential Uses.
- 2,858 acres were reclassified to Apartment, Hotel/Motel Uses.
- 838 acres were reclassified to Business Uses.

Most of these zoning reclassifications have taken place within the boundaries of the North Central Ocean Basin.

These figures indicate that the zoning ordinance has been subject to substantial changes during the past ten years and this compromises the ordinance's value as a growth management control. However, the zoning ordinance does provide a "conservation district" for protection and limited utilization of wetlands and stream valleys and "agricultural districts" for preservation of farm land.

Two additional mechanisms are available for the protection of prime agricultural land in Worcester County. All agricultural land is assessed for taxes on its value as farm land and not on the potential value as resort or commercial property (COE, 1976). The tax rate for agricultural land is lower than that for residential or commercial property. Another factor designed to preserve agricultural land in Worcester County was the recent legal ruling concerning the rezoning of agricultural land. This ruling resulted from a recent rezoning granted by the County for agricultural land on which a recreational community was to have been developed. Because the acreage in question was surrounded by agricultural land even after the rezoning was granted, the Maryland Court of Appeals reversed the rezoning (Pattey et al., vs. the Board of County Commissioners of Worcester County et al., March 29, 1974). As a result of this ruling rezoning agricultural land which is not contiguous to land already zoned for development should become increasingly difficult (COE, 1976).

2. Capital Improvement Programs

Ocean City is the only municipality in the North Central Ocean Basin which has a capital improvement program. These programs are generally 5 to 10 year schedules of municipal projects with their estimated costs. These programs are usually prepared annually and include revising the entire program and adopting the capital improvement budget each year as part of the regular operating budget. Proposed projects are reviewed for their ability to correct existing deficiencies and serve expected future growth. The program provides an indication of future needs and development trends.

Ocean City's capital improvement program is adopted annually and projects needs one year into the future. The major portion of the current annual budget is devoted to expanding and improving the City's water supply system.

3. Minimum Lot Sizes and Requirements for Private Septic Tank/On-Site Disposal Systems

Minimum lot sizes and requirements for private septic tank/on-site disposal systems have been established by the Environmental Health Administration (DHMH, Undated). The regulations establish standards for the design of single-family water and sewerage systems. The minimum allowable lot sizes for lots with individual sewage disposal and public or individual water supplies are summarized in Table III-1 .

Table III- 1. Minimum Lot Sizes for Homes with Individual Sewage Disposal Systems. [Source: DHMH (Undated)].

Percolation Rates (minutes Required for 1" Drop)	Minimum Area Using Individual Well & Sewerage (sq. ft.)	Minimum Area Using Public Water Facilities & Sewerage Systems (sq. ft.)
1 to 5	20,000	15,000
6 to 15	25,000	17,000
16 to 25	30,000	20,000
26 to 30*	40,000	30,000

* More than 30 minutes unacceptable.

Where community sewerage is available and individual water supply systems must be utilized, a minimum lot size of 10,000 square feet is required.

Soils which have seasonally high water tables require percolation tests during periods of maximum groundwater levels.

Ocean City does not permit septic tank or other on-site waste disposal techniques to be utilized within its corporate boundaries.

4. Regulation of Sewer Access

Regulation of sewer access has been granted to the counties by the State of Maryland. Counties have the right to refuse a request for access to a sewerline tie-in even if adequate capacity is available to treat the additional sewage (DNR, 1977). The law requires counties to provide for orderly expansion of sewer service in a manner consistent with county and local comprehensive land use plans. The law also includes the general authority to plan and stage the development of wastewater treatment system and to control the rate at which the capacity of a treatment plant becomes available to the public.

5. Open Space and Recreational Planning

Open space and recreational planning has become an increasingly important function of local and regional authorities.

Major tracts of land are owned by the Federal or State governments in or near the North Central Ocean Basin. The study area also contains numerous environmentally sensitive areas. These areas also provide open space and limited recreation.

WCPC (1976) has identified a series of "Park Land/Conservation" areas in the comprehensive plan. Approximately 29,000 acres of park land currently exist in Worcester County and are owned by the Federal and State governments. Assateague Island is open for camping and beach use. Annual attendance currently exceeds 1.5 million visitors and has grown significantly every year (WCPC, 1976). The plan contains recommendations for opening the northern federally-owned section of Assateague between the Ocean City Inlet and the state park for additional beach recreation.

The "Conservation" category in the plan includes those areas of the county which are either unsuited for development or areas in which development would have a significant adverse environmental impact. The category includes wetlands, tidal bays, the Pocomoke River, and stream valleys.

The 1969 Ocean City plan does not contain any land use categories for the preservation of open space or recreational areas.

C. FUTURE LAND USE

The Worcester County Comprehensive Plan identifies six general categories of future land uses: Ocean City, Suburban, Rural, Agricultural, Conservation, and Park Land (Figure III-1 and Table III-2). The County has proposed that these are not predictions of future uses as much as they are "a sound development concept capable of accommodating the projected population..." Therefore, the plan and its categories are intentionally general, in order to act as a general density and spatial guide.

Table III-2 . Future Land Uses in the North Central Ocean Basin.
[Source: Urban Pathfinders, Inc., (1976)].

	<u>Acres</u>	<u>Percent</u>
Ocean City	2,351	3.5
Suburban	14,834	22.0
Rural	16,805	25.0
Agricultural	23,475	34.8
Park Land	2,441	3.6
Conservation	<u>7,466</u>	<u>11.1</u>
	67,372	100.0

Ocean City. This category includes all of Ocean City from the Maryland-Delaware boundary to Assateague Island and encompasses 2,351 acres. Intensive development envisioned by the plan is anticipated to meet projected Ocean City growth from a current level of 1,500 permanent and 150,000 seasonal residents to 4,500 permanent and 310,000 seasonal residents in 2000.

Suburban. This category includes 14,834 acres of waterfront and near-waterfront property on the mainland, and includes approximately 25 percent of the basin. Uses projected for suburban areas include infill and revitalization development in Berlin and "a variety of residential, recreational and supporting commercial development" in the remaining suburban waterfront areas. An average residential density of ten units per net acre is recommended by the plan.

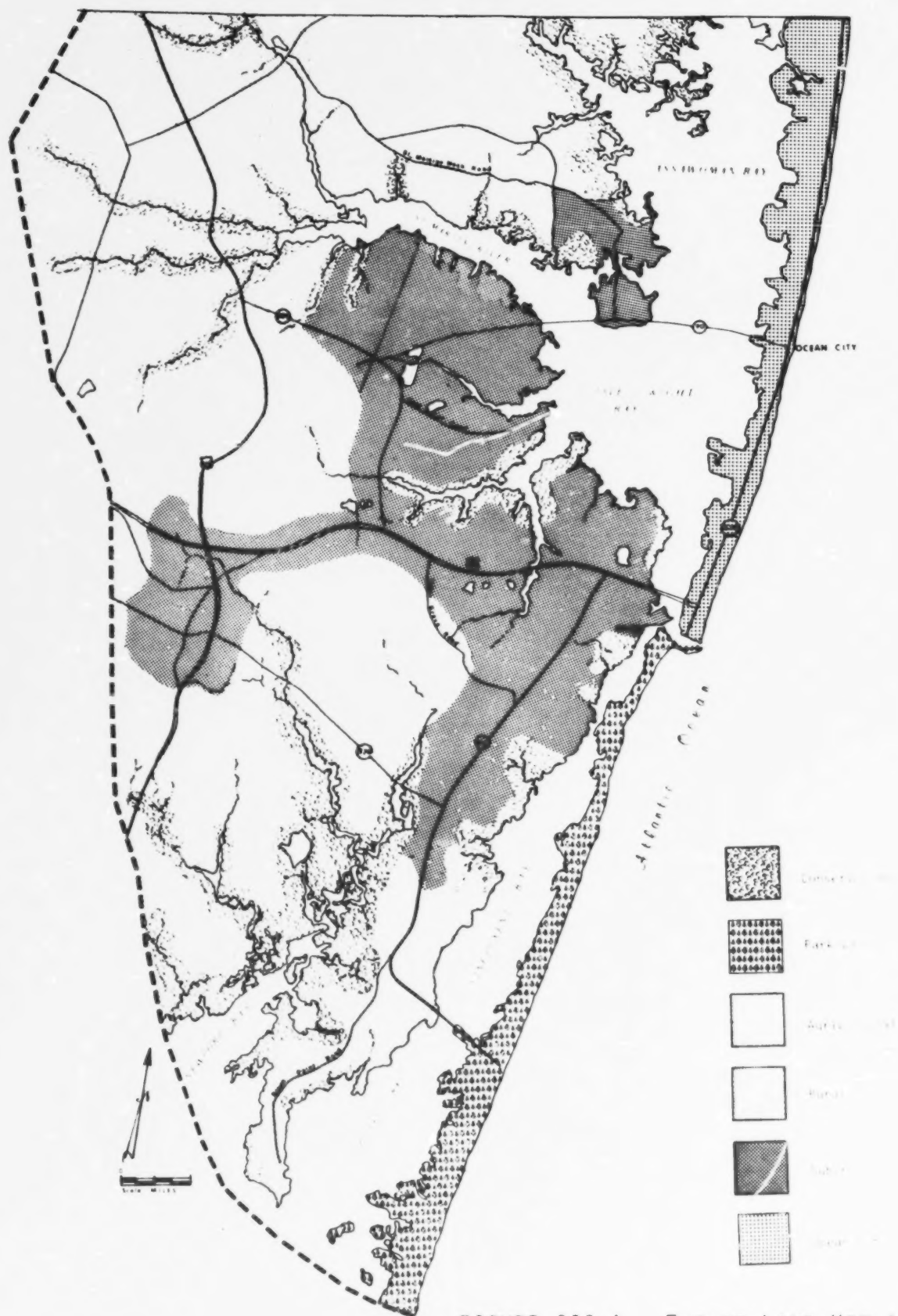


FIGURE III-1. FUTURE LAND USE IN THE NORTH CENTRAL OCEAN BASIN.
[SOURCE: Urban Pathfinders, Inc., (1976)].

Rural. The rural category includes 14,670 acres of the North Central Ocean Basin. The plan presumes that these areas will experience strong growth pressures, but that these pressures will be less than those in suburban areas. Development pressures in these areas will not be sufficient to support the costs of providing them with public services. A moderate density of one to two units per net acre is suggested. The plan proposes that soils in these areas are "generally capable" of accommodating septic systems.

Agricultural. Agricultural land is the largest suggested use in the plan (20,806 acres), and encompasses slightly more than one-third of the study area. Agricultural areas are located primarily in the north and northwest sections of the study area and in one large parcel between Upper Sinepuxent Neck and Berlin. The plan suggests that these areas are to "remain relatively unchanged during the planning period." Agricultural areas maintain minimum lot sizes, "on the order of one unit per net acre."

Conservation. The Conservation category includes nearly 7,000 acres of wetlands, tidal bays, and stream valleys. Protection of these areas is advocated in order to preserve environmental quality, especially clean water in the shallow bays. Zoning and subdivision controls are suggested for this purpose.

Park Land. Park Land is confined to 2,441 northern acres of Assateague Island, less than 4 percent of the North Central Ocean Basin. The plan recommends that this section of Ocean beach be developed for intensive recreation to relieve anticipated future crowding on Ocean City's beaches.

D. PROJECTED POPULATION

Projecting future populations of the North Central Ocean Basin is complicated by the significant seasonal population variation and uncertainties of the tourist-based economy. For example, Ocean City's estimated 1976 permanent or winter population of approximately 17,500 people increased during that summer to a maximum of approximately 179,000.

Currently available population projections were formulated before recent concern about fuel conservation and prices, and the development of severe transportation difficulties on the Eastern Shore. Three distinct categories of population comprise the total population in Worcester County on any given day (Morton Hoffman, 1973):

- Year-round (permanent) residents - live in the County for six months or more during the year.
- Overnight lodgers - reside in the County for a period ranging from one night to six months.
- Daytime visitors - spend only the day in the County.

In addition, analysis of the Basin's population is complicated by the fact that urban development is centered in Ocean City, and the population of the City is expanding rapidly. In contrast, the remainder of the Basin has an agricultural economic base and has had a slow growth rate. As a consequence, general County population data are not applicable for projecting growth in Ocean City.

Various estimates of future population growth in the Basin are in conflict. Each of the available projections appears to be an original estimate, and each appears to be based upon different assumptions about the area. Population projections for the Basin have been developed by:

- Maryland Department of State Planning [MDSP] (May, 1975)
- Morton Hoffman and Company, Inc. for the Maryland Environmental Service [MES] (April, 1973)
- Urban Pathfinders, Inc. for the Worcester County Planning Commission [WCPC] (April, 1976)
- George, Miles and Buhr [GMB] (1976)
- Whiteman, Requardt & Associates (May, 1977)

1. Projections of Permanent Population

Projections of the permanent population of Worcester County (including Ocean City) have been prepared by MDSP, Morton Hoffman, and Urban Pathfinders (Table III-3). These projections include average annual growth rates ranging from 1.4 to 3.7 percent. Only the WCPC projections extend to the year 2000.

Table III-3. Projections of Future Permanent Populations in Worcester County.

<u>Agency/Consultant Responsible for Projection</u>	<u>End-Point Year and Population</u>	<u>Projected Average Annual Growth Rate</u>
Maryland Department of State Planning	(1990) 36,190	2%
Maryland Environmental Service (Morton-Hoffman and Company, Inc.)	(1990) 48,000- 51,000	3.4 - 3.7%
Worcester County Planning Commission (Urban Pathfinders, Inc.)	(2000) 36,000	1.4%

Analysis of these figures indicates that they may all be low due to the increasing number of year-round visitors Ocean City has been experiencing. During the period 1971-1976 the town experienced a 20 percent growth rate in permanent population.

Due to the importance of the Basin as a resort recreational area, permanent population projections are not of primary importance in determining peak wastewater flows.

2. Projections of Seasonal Population

Projections of seasonal populations in Worcester County and/or Ocean City have been prepared by Morton Hoffman, Urban Pathfinders and Whitman, Reguardt & Associates (Table III-4).

Morton Hoffman (1973) delineated a market area from which most of the seasonal and permanent population would be derived. The area encompassed all of the State of Delaware, four counties in New Jersey, all of Maryland

except the three westernmost counties, the District of Columbia, and approximately 25 counties and independent cities in Virginia north of Richmond. Baltimore and Washington were expected to contribute most of the anticipated growth.

Seasonal population projections were prepared considering several development alternatives for Ocean City and Worcester County. The alternative producing the greatest population increase included no limitations to growth and assumed waterfront construction anywhere in Worcester County. The alternative producing the smallest population increase limited growth to Ocean City and contiguous areas. No additional waterfront construction would be permitted by the County. Worcester County was divided into several subareas. The North Central Ocean Basin contains part of Subareas 1, 2, 3 and 4, Ocean City, North County, Sinepuxent, and Berlin, respectively.

Presently, 3.0 percent (203,000 persons) of the population in the market area is in Worcester County on a peak day (Morton Hoffman, 1973). Although the peak daytime population is not expected to continue to increase rapidly, peak populations will occur on more days throughout a single tourist season than in the past. By 1990, Worcester County is expected to attract as much as 5.8 percent of the regional population on a peak day, or 490,000 to 575,000 persons (Morton Hoffman, 1973).

The Morton Hoffman population projections do not vary substantially with each of the development alternatives because Ocean City will continue to attract most of the population in the County on any given day. By 1990, Ocean City's share of the total peak daytime population is projected to range from a high of 346,000 to 401,000 persons, or 70 percent of the total, under the highest projection, to 380,000 to 441,000 persons, or 84 percent of the total, under the lowest projection (Table III-4).

Three critical assumptions are incorporated into the Morton Hoffman population projections for 1980 and 1990.

- In each development alternative, Ocean City would be intensively developed before the rest of the County. Only after Ocean City reached a saturation level would the rest of the County experience a "boom". However, development in the County would not exceed the intensity of development in Ocean City before the year 2000.

- Extensive and intensive use of the Assawoman, Isle of Wight, Sinepuxent and Chincoteague Bays for fishing, boating, and swimming would occur in certain alternatives. Although environmental degradation of the bays might result from such intensive use, the projections do not account for possible accompanying decreases in Worcester County recreational demand.
- A large investment by state and local funds would be needed to upgrade the highways necessary to sustain significantly higher traffic volumes and reduce travel time; to improve the intracity movement of vehicles and people; and to provide additional public services to satisfy the daily needs of the increased population. Problems with this assumption include the fact that road expansion no longer can take place within Ocean City. Also, concern has recently arisen over traffic congestion to the resort area from the Washington, D. C. - Baltimore areas (Maraniss, 1977). Projects to clear points of congestion along the route could cost as much as \$200 million and may not be started until 1982, if ever.

The Worcester County Comprehensive Plan prepared by Urban Pathfinders under the auspices of the Worcester County Planning Commission, considered that two factors would increase the tourist population.

- The metropolitan areas from which Worcester County draws its tourists has been increasing by 20 to 25 percent per decade and is expected to grow during the foreseeable future at approximately the same rate.
- The national increase in time, as well as money, available for leisure activities will combine with an increasing tributary population to produce an estimated peak visitor population of 485,000 by the year 2000 in Worcester County (Table III-4).

The plan projects that Ocean City will double its peak seasonal population and will remain the center of the County's recreation industry. The plan also anticipates that recrea-

tional development will rapidly increase on the mainland, particularly in the Berlin area and on the Sinepuxent Neck. However, this assumption is dependent on the availability of central sewer services.

Whitman, Requardt & Associates assumed that the ultimate development of Ocean City would occur during the next 30 years and that this development would proceed at a relatively uniform rate. However, physical restrictions on the land (wetlands, open space, etc.) would limit growth in the City to 60 percent of the developable land. Whitman, Requardt projected that average, daily peak weekend populations in Ocean City would increase at an average annual rate of 1.3 percent from 200,000 in 1976 to 275,000 in 2000 (Table III-4).

Table III-4. Projections of Peak Seasonal Populations in Ocean City and Northern Worcester County.

Agency/Consultant Responsible for Projection	OCEAN CITY		NORTHERN WORCESTER CO.	
	End-Point Year and Population	Average Annual Growth Rate Assumed	End-Point Year and Population	Average Annual Growth Rate Assumed
Worcester County Planning Commission (by Urban Pathfinders)	(2000) 310,000	2.9%	(2000) 145,000	7.6%
Ocean City (by Whitman, Requardt & Associates)	(2000) 275,000	1.3%	----- -----	-----
Maryland Environmental Service (by Morton- Hoffman Associates)	(1990) 346,000-441,000	2.9-4.0%	(1990) 64,000-126,000	2.7-4.9%
George, Miles and Buhr (from Worcester County Comprehensive Plan for Water and Sewerage Systems)	(2000) 205,000*	4.4%	(2000) ~ 88,000**	Insufficient data to deter- mine
* Equivalent Population utilized by GMB for wastewater flow purposes assuming 100 gpcd.				
** Estimate from the 201 Facility Plan and County Water and Sewer Plan (1976).				

3. Service Area Population Projections

Seven specific sewer service areas (Figure III-2) have been delineated by GMB in the Facilities Plan for determining flow to the proposed Mainland STP. In the development of population and flow projections for these areas (Table III-5) year-round resident and summer resident populations were evaluated. Several sources were reviewed by GMB to determine these populations and the future wastewater flows.

To determine Ocean City population, GMB utilized the lowest growth alternative of the Morton Hoffman projections. GMB further assumed that Ocean City will continue to grow at approximately 3.5 percent per year, producing a maximum wastewater flow of 20.5 mgd in the year 2000.

West Ocean City is presently an area of high density population with failing septic tanks. GMB determined existing populations in this service area by conducting house counts and examining existing zoning. Projections of future summer resident growth prepared by GMB assumed that rapid initial growth would occur from 1980 to 1985 (12.5 percent per year) and that sewerage service would be provided by 1980. GMB estimated that after the initial rapid growth, the growth rate would decline. GMB estimated that the average annual growth rate would decrease from 1985 to 1990 to 6.1 percent and even lower between 1990 and 1995. Finally it has been estimated that between 1995 and 2000 the West Ocean City growth would equal that of Ocean City (3.5 percent).

Berlin is currently conducting a 201 Facilities Plan Study. GMB utilized projections presented by WRA (1976). These projections are consistent with a general county growth rate of two percent per year.

The U. S. Route 50 service area is presently populated by trailer camps and single-family residences which are located close to the highway. Due to poor soil permeability in the area, growth has been restricted. With the advent of regional sewerage service to this area, GMB assumed that growth would increase at a faster rate than the Worcester County Comprehensive Plan proposal of two percent annually. GMB predicted that existing and planned seasonal residential facilities will be at capacity by the year 2000, with

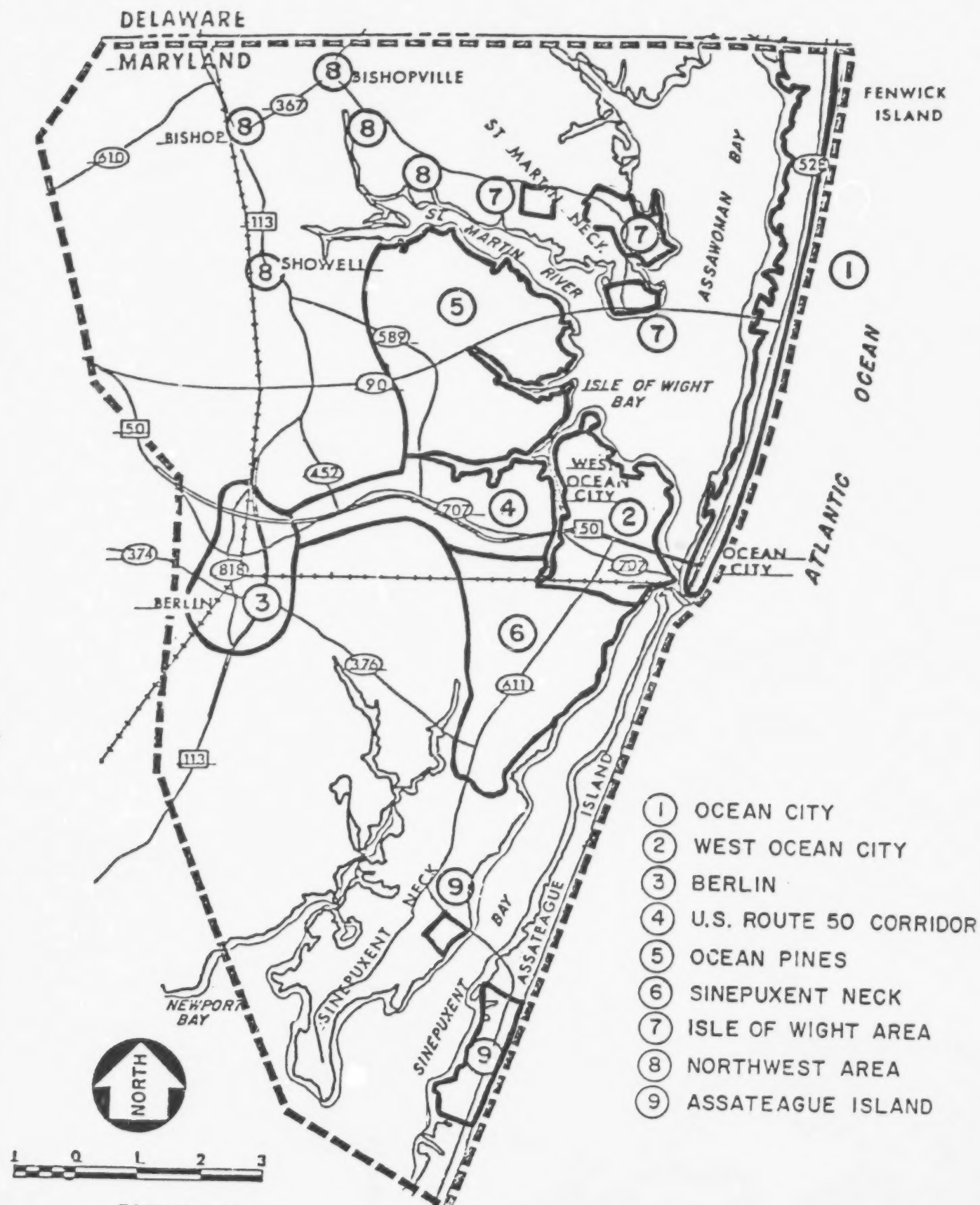


FIGURE III-2. SEWERAGE SERVICE AREAS DELINEATED BY GMB (1977).

Table III- 5. Projected Sewer Service Area Population and Wastewater Flow Estimates Prepared by GMB (1976).

Service Area	Population		Wastewater Flow ¹
	1975	2000	2000
Ocean City	72,500*	205,000*	20.5 mgd
West Ocean City	6,800*	25,000*	2.5 mgd
Berlin	4,000*	7,000*	0.96 mgd
U.S. Route 50 Corridor	N/A	9,809*	0.9 mgd
Ocean Pines	~3,160*	22,320*	2.22 mgd
Sinepuxent Neck	N/A	16,220*	1.20 mgd
Isle of Wight Area	N/A	4,000*	0.4 mgd

* Based on seasonal peak populations.

** Includes new industrial contributors.

¹ GMB assumed 100 gpcd in all cases except the Sinepuxent Neck service area where 78 gpcd was utilized due to numerous campgrounds and trailer developments.

incremental expansion to that date. Also, undeveloped areas were estimated to attain a density of four persons per acre which is typical of presently developed areas.

The Ocean Pines service area currently contains 6,484 platted lots. From existing growth records, development of this area was not expected to reach capacity by the year 2000 (GMB, 1976). The future population was based upon present growth rates with an average expansion of 135 units per year (4.0 people per DU). GMB assumed that undeveloped areas along Turville Neck and Beauchamp Road would achieve a density of four persons per acre, with a population of 6,200 people by the year 2000.

In establishing population and flow forecasts for the Sinepuxent Neck service area, GMB found it necessary to establish assumptions for expansion based on growth of similar rural areas in Worcester County. This area presently consists almost exclusively of trailer and camp grounds. GMB estimated

that the year 2000 wastewater flow will result from the filling during summer months of all available sites presently planned. Other currently undeveloped areas were expected to develop net concentrations of four persons per acre east of Route 611 and one person per acre west of Route 611 by the year 2000.

The Isle of Wight service area has been included in the Worcester County Comprehensive Plan as an area for high density growth. GMB projected that the area will develop to a year 2000 density of six persons per acre and that growth would not occur until after expansion of other mainland areas has occurred.

E. CONSISTENCY OF THE APPLICANT'S PROPOSED PROJECT WITH THE COMPREHENSIVE PLAN

The applicant's proposed expansion of wastewater treatment and collection facilities in the North Central Ocean Basin is consistent with the Worcester County Comprehensive Plan. Service areas for the major interceptors include only the Ocean City and Suburban land use categories proposed in the plan. The close relationship between the facilities plan and the County's Future Land Use Plan results in numerous instances where the facilities plan fulfills recommendations in the land use plan. These include two separate recommendations for central water and sewer service in the suburban zones, the designation as "critical areas" of those locations with failing septic systems, and implementation of the suggestion that the County prepare a new water and sewer master plan.

Potential conflicts of the proposed project with the plan result principally from the extensive areas of land to be sewerred in addition to currently developed areas. Public service recommendations in the plan indicate that services should be self-supporting, but much of the area to be serviced by interceptors is currently sparsely inhabited. Staging the extension of interceptors would more closely follow two of the plan's objectives:

- "New service should be extended only to areas where and when central sewer facilities are required to accommodate anticipated higher density growth."
- "Service area populations must be great enough to support entirely the costs of sewer service to that area."

In addition, development of the magnitude anticipated by both the Future Land Use Plan and the facilities plan may violate one of the plan's objectives, maintenance of water quality in the coastal bays, through increased urban and suburban nonpoint source pollution.

F. EVALUATION OF THE COMPREHENSIVE PLANS

Ocean City's plan is out-of-date and is currently being revised. Therefore, the current plan cannot be relied upon for this analysis.

Berlin's plan was revised recently. The plan coordinates with Worcester County's approach of confining growth in the western county to existing towns such as Berlin. Its acceptance of growth matches its potential. Sprawl is discouraged. Deficiencies in services, primarily recreation and central-commercial, are identified and plans are presented for improving the central business district and increasing available recreational land. The desired level of recreation and industrial uses may not be attained, but this does not limit the plan.

Worcester County's 1976 plan has a major deficiency: recreation resources and some public services are not projected to be adequate for projected populations. At first the County's plan appears reasonable and complete. The critical relationship between growth and services is identified and stressed. Unfortunately, the critical services of highway capacity and water supply are clearly limitations which are not successfully resolved.

As has been identified in Public Services (Section II-B-4) and Projected Population (Section III-D) severe traffic congestion has been experienced on routes to Ocean City and no relief is in the immediate future. If access to Ocean City were substantially improved, no room remains in Ocean City itself for major transportation improvements, and existing systems are nearing capacity. The plan identifies intercept lots and a bus system from the mainland as a viable solution, but no progress has been made on establishing a joint Ocean City/Worcester County venture to investigate this proposal.

As identified in Water Supply Impacts, estimated water demand used in planning water supply facilities is much lower than projected sewage flows. Either planned waste treatment facilities are greatly oversized or current plans for water supply are inadequate. This question is not resolved satisfactorily by the plan.

Worcester County's plan recognizes the critical problem of protecting the recreational resources which attract visitors to the resort and the county. Nevertheless, the problems of beach capacity and boating capacity are not resolved effectively.

The plan suggests immediate efforts to open the northern portion of Assateague Island (north of the State Park) to intensive ocean-front recreation. This will be an issue in the next two to three years as a master plan for the National Seashore is developed.

The exceeding of recreational capacity on Ocean City's beaches and the coastal bays, traffic congestion, and potential shortages in future water supply could seriously impair the future of the North Central Ocean Basin as a major, growing, recreational resort. These problems are not resolved in the Worcester County plan.

SECTION IV

ENVIRONMENTAL EVALUATION OF THE APPLICANT'S PROPOSED PROJECT

The following section of this environmental impact statement contains a description of the impact of the applicant's proposed project upon the current and future environment of the North Central Ocean Basin. The analysis includes a discussion of unavoidable adverse impacts, short-term use of the environment vs. long-term productivity, and irreversible and irretrievable resource commitments. This analysis incorporates the information developed in the preceding sections of the statement. Information developed in this discussion is incorporated into the analysis of feasible alternatives to the proposed project (Section V).

IV. ENVIRONMENTAL EVALUATION OF THE APPLICANT'S PROPOSED PROJECT

A. Environmental Impacts of the Applicant's Proposed Project

Construction and operation of the proposed wastewater treatment facilities in the North Central Ocean Basin will have both beneficial and adverse environmental consequences. Although the consequences of this project are intended to be strictly desirable, some of the adverse impacts which will occur cannot be avoided. However, many of the adverse impacts can be minimized or mitigated through careful planning and enforcement of regulations designed to protect environmental quality. Minimizing long-term environmental impacts can also occur through a complete analysis of alternatives to the proposed project and selection of any alternative which produces greater benefits with fewer adverse consequences than the original proposal.

An assessment of the environmental impacts resulting from the applicant's proposed project is included in the following section. Each of the impacting actions in the discussion is identified as "primary" or "secondary". Primary impacts result directly from the construction and/or operation of the proposed project. Secondary impacts result from activity which follows completion of the proposed project. Impacts have also been assessed as being "short-term" or "long-term" and "beneficial" or "adverse". The degree of impact has also been projected as minimal, moderate or significant. Many of the decisions concerning the nature and degree of an impact are discretionary. Decisions included in the discussion were formulated after extensive analysis and include both environmental, social and engineering considerations. In many cases, the degree of impact cannot be accurately projected. Quantitative data concerning the effects of many of the impacting actions included in this section are not generally available. Some issues, such as effluent chlorination or sludge incineration, have recently become national public health issues, but definitive information concerning their environmental impact is not available. In these cases, the degree of impact can only be listed as "potential". Mitigating measures to reduce adverse impacts are also mentioned in the discussion. Many of these mitigating measures are normally practiced. Other mitigating measures may require the development of new and complex programs to alleviate potentially adverse impacts.

Impacts of the project upon the environment of the North Central Ocean Basin are discussed in the following order:

Physical Environment

- Surface Water Quality
- Surface Water Flow
- Groundwater Quality
- Water Supply
- Air Quality
- Biology
- Natural Resources

Social Environment

- Public Health
- Land Use
- Aesthetics
- Recreation
- Archaeological and Historic Sites
- Social and Economic Factors

1. Surface Water Quality

The applicant's proposed project will have several impacts upon surface water quality in the North Central Ocean Basin. The resulting water quality will depend upon the difference between the primary beneficial consequences (relief of failing septic systems and small sewage treatment facilities) and the secondary adverse consequences (increased nonpoint source loading and recreational use of the basin) of the proposed project. Sufficient data are not available to permit EPA to quantitatively assess the total impact of the applicant's proposal on surface water quality. EPA recognizes that adverse secondary consequences of the proposed project can be mitigated through water management and has identified impacts where management is appropriate. Quantitative statements of "adverse" consequences are not intended to distract the reader from the "beneficial" impacts of the applicant's proposal but result from the availability of quantitative data for those particular impact assessments.

Relief of malfunctioning and clustered septic systems, in areas such as West Ocean City, will reduce the loading of the coastal bays and their tributaries from these pollutant sources. Malfunctioning septic tank effluents contain high concentrations of coliform bacteria, BOD, nitrogen, and phosphorus. Both CMB (1975) and WBA (1976) have defined the preservation and/or maintenance of water quality in the coastal bays as major goals of their respective programs. Water quality in the coastal bays and their tributaries requires improvement. Herring Creek and Turville Creek which drain the West Ocean City-Route 50 Area have been closed to shellfishing because of excessive coliform concentrations.

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	4. No Action	V-42	4/B2
VI.	PRELIMINARY CONCLUSIONS	VI-1	4/B5
	REFERENCES	R-1	4/B8
	APPENDIX A - SPECIES LISTS	A-1	4/C6
	APPENDIX B - SPECIFIC ANALYSIS TECHNIQUES	B-1	4/E2
	APPENDIX C - CORRESPONDENCE	C-1	4/F2

Based upon population data presented by GMB (1976) and failing septic tank data presented by WRA (1976), EPA calculated that the applicant's proposed service area contains approximately 3,115 septic tanks. Approximately 134 of these septic tanks are subject to failure at any time. Loadings to the coastal bays and their tributaries from these failing septic systems were calculated based upon average per capita wastewater flows of 75 gpcd and effluent similar to that of weak domestic sewage (Metcalf & Eddy, 1972). Daily and annual load of four constituents are:

Suspended solids	29 lbs/day	10,585 lbs/yr.
BOD ₅	29 lbs/day	10,585 lbs/yr.
Total Nitrogen	5.9 lbs/day	2,154 lbs/yr.
Total Phosphorus	1.7 lbs/day	621 lbs/yr.

Point-source effluent loading of the near shore Atlantic Ocean from the North Central Ocean Basin will be altered as a result of the applicant's proposed project (Table IV-1). WRA (1976) assumed that upgrading treatment processes from primary to secondary would result in 95, 40, and 15 percent reductions in BOD, total phosphorus, and total nitrogen, respectively. The decrease in total BOD load will more than compensate for increased influent loads from a larger service population. BOD loading at the design capacity of 29.4 mgd will be only 18 percent of the current loading at 9 mgd. Total phosphorus and total nitrogen loadings will be generally unaffected by upgrading the treatment process. At the design capacity of 29.4 mgd, total phosphorus and total nitrogen loads will be 96 and 72 percent greater, respectively, than current loads at 9 mgd.

Table IV-1. Existing and Projected BOD, Total Phosphorus, and Total Nitrogen Loads to the Atlantic Ocean from the Proposed Sewage Treatment Facilities in the North Central Ocean Basin.

Design Flow (mgd)	Type of Treatment	BOD		Total Phosphorus		Total Nitrogen	
		Conc.* (mg/l)	Load (lbs/day)	Conc.* (mg/l)	Load (lbs/day)	Conc.* (mg/l)	Load (lbs/day)
9	Primary	275**	20,600	10	750	30	2,250
12	Secondary	15	1,500	6	600	25	2,500
20.5	Secondary	15	2,560	6	1,030	25	4,270
29.4	Secondary	15	3,680	6	1,470	25	6,130

* Assumed by WRA (1976)

** Interim permit limit

Non-point pollutant loads to the coastal bays from urban runoff will increase as a result of development in the proposed service area. According to the future land use plan, approximately 11,000 acres of vacant land within the proposed service area could be developed at a density of 10 dwelling units/acre. Potential increases in sediment and pollutant loads to the bays were calculated for the 16 largest privately-owned tracts of land, and the total service area if developed to capacity (Table IV-2). The projected non-point runoff from urban development in the service area would significantly increase BOD loading to the bays. However, non-point source loads of total nitrogen and total phosphorus would not equal the loads removed by relief of point sources until the area was developed to near capacity.

Data presented by WRA (1976) indicated that pollutant loads to the coastal bays and their tributaries from point sources are approximately 1,170 lbs/day BOD₅, 1,043 lbs/day total nitrogen, and 256 lbs/day total phosphorus. These loads combined with the previously calculated loads from malfunctioning septic tanks would be removed from the coastal bay system if the proposed project were implemented. When combined with the non-point source loads calculated in Table IV-2 for the 16 largest projected developments, BOD₅ loading increases by 1,915 lbs/day, but total nitrogen and total phosphorus loads decrease by 688 lbs/day and 150 lbs/day, respectively. At total development, BOD₅ loading increases by 5,930 lbs/day, and total nitrogen and total phosphorus would decrease by 229 lbs/day and 13 lbs/day, respectively. Therefore, the reductions of pollutant loads from point-sources and areas of failing septic tanks may be offset by increased urban runoff, and a significant net change in water quality of the coastal bays may not result from the applicant's proposed project.

Discharge from the proposed outfall may enter the coastal bays through Ocean City Inlet. Dye studies to determine the fate of materials discharged at the proposed site have not been performed. However, satellite photographs indicate that a large sediment plume forms around Ocean City Inlet during ebb tides. This plume may extend southward to the proposed outfall and may be drawn back into the coastal bays during flood tide. The amount of effluent that could be drawn into the bays and the chance of nutrient accumulation around the inlet cannot be determined without dye studies. Dye studies will be performed in July, 1977 and the results will be incorporated into the final EIS, if possible.

Table IV-2. Non-point Sediment and Pollutant Loads to the Coastal Bays if the Sixteen Largest Privately-owned Tracts of Land, and Total Vacant (Buildable) Land in the Proposed Service Area, are Developed to Capacity. [Loading Coefficient Source: Real Estate Research Corp. (1974)].

	<u>Sediment</u> <u>(lbs/day)</u>	<u>BOD</u> <u>(lbs/day)</u>	<u>Nitrogen</u> <u>(lbs/day)</u>	<u>Phosphorus</u> <u>(lbs/day)</u>	<u>Suspended</u> <u>Solids</u> <u>(lbs/day)</u>	<u>Fecal</u> <u>Coliforms</u> <u>(number/day)</u>
(a) Largest Tracts of Land						
<u>Drainage Basin</u>						
Isle of Wight (3,400 acres)	52,600	2,200	255	76	92,400	5.2×10^{10}
Newport Bay (720 acres)	10,800	450	52	16	19,400	1.1×10^{10}
Sinepuxent Bay (700 acres)	<u>11,125</u>	<u>465</u>	<u>54</u>	<u>16</u>	<u>19,900</u>	<u>1.1×10^{10}</u>
TOTALS (4,800 acres)	74,525	3,115	361	108	131,700	7.4×10^{10}
(b) Total Vacant (Buildable) Land (11,000 acres)	169,860	7,130	820	245	305,000	1.68×10^{12}

2. Surface Water Flows

Leopold (1968) proposed that land use changes affect the hydrology of an area by altering peak flow characteristics, changing the total runoff volume, altering water quality, and changing hydrologic amenities. All of these adverse impacts will occur as secondary consequences of the proposed project. In addition, stream flows which are supported by treatment plant and septic tank discharges will be reduced when these facilities are relieved.

Reduction of normal streamflow will result as both a primary and secondary consequence of the proposed project. Streamflows supported by effluent discharges from small treatment plants and from septic tanks will be reduced when these facilities are relieved. This reduction in flow may be accompanied by improved water quality in the streams because pollutant loads to the streams will also be reduced. The flow of the streams in the North Central Ocean Basin is supported by groundwater. Increased development accompanied by increasing areas of impervious surfaces will block areas through which precipitation may enter the ground and will direct runoff rapidly over recharge areas. This will result in a reduction in the quantity of groundwater available to support base flow in these streams.

Increased flooding of small streams will result as a secondary consequence of the proposed project. Tourbier (1973) proposed that the following changes in runoff volumes occur with increasing urbanization:

<u>Percentage of Precipitation as</u>	<u>Natural Ground Cover</u>	<u>Paved Surfaces</u>		
		<u>10-20%</u>	<u>35-50%</u>	<u>75-100%</u>
Evapotranspiration	40%	38%	35%	30%
Shallow Infiltration	25%	21%	20%	10%
Deep Infiltration	25%	21%	15%	5%
Runoff	10%	20%	30%	55%

As the area of impervious surfaces increases, larger percentages of rainfall are directed into the drainage network. Most of the precipitation falling upon developed areas is directed rapidly to local streams rather than being incorporated into the groundwater and being released slowly to the streams. Increased urbanization is manifested in a larger number of rapidly rising floods and increased heights of flood peaks. The most significant effect of urbanization is to increase the occurrence of small floods (Stankowski, 1974).

Flooding is a significant problem in the North Central Ocean Basin, and stream channelization has been used to alleviate the effects of flooding in agricultural areas. However, by promoting the rapid flow of water from an area, channelization also facilitates the transport of nonpoint-source pollutants. Residents in suburban areas will also be subjected to flooding and will request that adequate drainage be provided to protect their lives and property. This drainage has been provided to small suburban areas near Ocean City through channel modification. Mosquitos often proliferate in undrained areas in channels where water becomes stagnant. These areas will also concern residents in the developing areas, and these concerns will be used to further modify the drainage patterns of the area.

Reduction of hydrologic amenities will also occur as a result of secondary activities. Stream channel stability will be disrupted by increased flooding. Unstable stream banks are generally scoured or muddy, unvegetated, and littered with debris. In addition, refuse accumulates within the streams and in the marshes. Finally, the biological stream populations are altered by increasing urban pollution and accumulation of debris. These changes reduce the aesthetic value and the recreational potential of the streams.

3. Ground Water

The proposed project will also have an impact upon the quantity and the quality of ground water in the study area. The principal source of shallow ground water in the North Central Ocean Basin is precipitation falling directly upon the area and not water traveling from distant sources through underground channels. Recharge areas for the deeper aquifers are generally outside of the study area. Ground water quality in the study area generally meets U. S. Public Health Service standards. Primary impacts of the proposed project will include reduction of the volume of septic tank effluent which recharges shallow aquifers and subsequent improvement in ground water quality. Secondary impacts will include reduction of water available for ground water recharge and increased contamination of ground water by urban runoff.

Improvement of ground water quality will result from the elimination of septic tanks in areas where shallow wells are used as water supplies. The seasonally high water table which makes most of the study area "unsuitable" for

septic tank operation also favors the rapid transport of sewage contaminants through the ground water. The elimination of these septic tanks will result in a minor lowering of the ground water table by removing a recharge mechanism. The improvement in the quality of the ground water should be more beneficial than any adverse effects resulting from a lower recharge rate. In addition, ground water quality in aquifers recharged by local streams will improve with the elimination of the small treatment facilities discharging effluent into these surface waters.

Reduction of ground water recharge will result as a secondary impact of the proposed project. Two mechanisms will be responsible for this reduction: increased areas of impervious surfaces and increased rate of surface runoff. Impervious surfaces scattered throughout the study area will block local recharge areas. In addition, these impervious surfaces will direct runoff rapidly into streams draining the area. Rapidly flowing runoff cannot effectively recharge the ground water. The lower ground water levels resulting from this development will not be accompanied by improved water quality. In addition, the effect upon available ground water will be greater than that created by the elimination of septic tanks because of the potential extent of secondary development.

Increased ground water contamination by urban runoff will result from secondary development. Increased development in the North Central Ocean Basin will increase the volume of urban runoff entering surface waters and recharging the Pleistocene aquifer in some areas. The result may be the loss of ground water as a water supply in developed sections of the study area.

4. Water Supply

All water supplies in the North Central Ocean Basin are taken from groundwater sources. All future supplies are expected to be provided by groundwater sources. No surface waters are available as a potable water supply in the area due to their salinity.

The raw water supply for the Town of Ocean City is currently pumped from the Ocean City-Manokin aquifer. This aquifer has sufficient capacity to serve the projected year 2006 population (Whitman, Requardt & Associates, 1977).

The estimated year 2000 water demand is 13.75 mgd. This figure conflicts with the GMB year 2000 Ocean City wastewater flow of 20.5 mgd.

In order for Ocean City to serve the year 2000 projected population, several major changes are required to the water supply system (Whitman, Requardt & Associates, 1977). These changes include:

- installation of altitude valves at the elevated storage tanks,
- cleaning and lining of the pipe network between 13th and 26th Streets, and
- increased flow capacity between 10th and 100th Streets for domestic and fire fighting use. To accomplish this, a new 20-inch main must be installed parallel to the existing lines.

Since potable water is available from one or more aquifers throughout Worcester County, no regional water system dependent upon a single source or supply has been planned. Most of the potable water in eastern Worcester County is currently withdrawn from the Pleistocene aquifer, with some additional supply being provided by the deeper Pocomoke and Manokin aquifers. Pleistocene deposits are potentially among the most productive aquifers in Maryland and are capable of extensive development (MSDP, 1969). However, saltwater has penetrated the aquifers in areas near the ocean and tidal marshes. Water at depths greater than 50 feet is generally free of salt.

In the Worcester County Comprehensive Plan for Water and Sewerage Systems, the 1980 water demand for eastern Worcester County was determined to be approximately 3.5 mgd. No further projections were available. This withdrawal can be accommodated by the Pleistocene aquifer.

5. Air Quality

Adverse primary impacts of the proposed project on air quality will result from sludge incineration. Sludge incinerators can emit a variety of air pollutants depending upon the characteristics of the sludge and the design and operation of the incinerator. The principal air pollutant emitted from an incinerator is suspended particulate matter.

The applicant's proposal is to incinerate primary sludge from the Ocean City plant at the existing incinerator. All other sludge will be land applied. Primary treatment usually generates 750 pounds of dewatered sludge per million gallons

of sewage (Metcalf & Eddy, 1972). At 20.5 mgd, approximately 7.7 tons/day of sludge will have to be incinerated. The existing incinerator was designed to burn about 350 pounds of sludge per hour. However, it can burn as much as 600 pounds per hour. At present the incinerator is operated six days per week, 14 hours per day, with a sludge loading of approximately 400 pounds per hour (WCSC, 1977, Personal Communication). To burn all of the primary sludge produced during 20.5 mgd treatment, the incinerator would have to be operated at 600 lbs/hour for 25.6 hours/day. Therefore, 0.5 tons per day of primary sludge would have to be disposed of in some other manner.

The existing incinerator is equipped with a scrubber to remove particulate matter from the exhaust gas. The only emissions tests were completed at the time of start-up. Particulate emissions were measured as 0.1 grains/scf at the design capacity (BAQNC, 1977 Personal Communication).

The only emission data available is 0.1 gr/scf (228 mg/m³) at 350 lbs/hour sludge feed. Assuming that the emission rate is proportional to the sludge feed rate, at 600 lbs/hour emissions would be 391 mg/m³. Maximum short-term, ground level concentrations calculated after Turner (1970) are shown in Table IV-3.

Table IV-3. Maximum Short-Term Particulate Concentrations from the Ocean City Incinerator.

Stability Class	Distance to Point of Maximum Impact (m)	Concentration ($\mu\text{g}/\text{m}^3$)
A	690	35
B	400	37
C	260	41
D	130	44
E	100	41
F	80	22

Because the meteorological conditions that produce these concentrations do not persist for extended time periods they would last for approximately 15 minutes. Particulate concentrations during a 24-hour period would be 36 percent of these values (Turner, 1970). The maximum 24-hour impact of the incinerator would range from 8 $\mu\text{g}/\text{m}^3$ to 16 $\mu\text{g}/\text{m}^3$.

There are no air quality monitoring stations in the study area. The applicable primary standards for particulates are:

Annual Average 75 $\mu\text{g}/\text{m}^3$
 24-hour maximum 260 $\mu\text{g}/\text{m}^3$

The predicted 24-hour peak impact is less than seven percent of the 24-hour standard. Therefore, the impact of particulate emissions will be minimal.

Pollutants other than particulates may be emitted from a sludge incinerator, depending on their properties and concentrations in the sludge. These pollutants include heavy metals such as mercury, lead and nickel, and organics such as pesticides and PCB's. The effect of incineration upon these pollutants is varied. It is possible that they could volatilize and be emitted as a gas, become attached to particulates and be removed in the scrubber, or remain in the ash. Most of the hazardous or potentially hazardous metals, with the exception of mercury, will not disproportionately appear in stack gases but will be converted to oxides and appear in the particulates removed by scrubbers and in the ash (EPA, 1975).

The only measurement of heavy metals concentration in the Ocean City sludge was made in August 1976. The mercury concentration was 0.90 $\mu\text{g/l}$ in dewatered sludge. Of all the metals that could be contained in sewage sludge, mercury (Hg) has the greatest potential for adverse impact. High temperatures in incinerators decompose mercury compounds to volatile mercuric oxide or metallic mercury. Tests of five incinerators equipped with scrubbers showed an average emission factor of 1.68 grams of mercury emitted to the atmosphere per ton of dry sludge incinerated (EPA, 1974). However, this varied widely depending on the characteristics and source of the sewage.

In accordance with Section 112 of the Clean Air Act Amendments of 1970, a national emission standard for mercury was promulgated in October 1975. The standard limits the atmospheric discharge of mercury from the incineration and drying of wastewater treatment plant sludges to a maximum of 3,200 grams/day. This limit is based on maintaining an average ambient mercury concentration of 1 $\mu\text{g/m}^3$ over a 30-day period.

Assuming that the Ocean City sludge weighs 70 lb/ft^3 , the concentration of Hg in the sludge is 0.364 $\mu\text{g/lb}$ or 0.73 kg/ton . If 7.7 tons/day are incinerated the Hg emissions will be 5.6 gm/day . This is approximately 0.2 percent of the allowable established by EPA.

Toxic substances can also be emitted from the incinerator because of the content of pesticides or other organic compounds in the sludge. Unfortunately, very little data are available on the concentrations of these materials in municipal sludge or their fate in an incinerator (EPA, 1975). No data exists on the concentration of these compounds in the Ocean City sludge.

Rapid thermal degradation of most pesticides has been shown to begin at approximately 500°C (930°F) with near total destruction at 900°C (1,650°F) (Snell, 1970). The PCB's are even more thermally stable than most pesticides. However, tests on municipal sludges showed total destruction of PCB's was possible when oxidized in combination with sewage sludge and with an exhaust gas temperature of 1,100°F (Sebastian, 1974). Temperatures of 1,600°F were required when PCB's were handled separately. Normal temperatures for sludge incineration exceed 1,300°F. Based on the limited evidence available, Farrell and Salotto (1973) concluded that pesticides and PCB's appear to be destroyed in incineration of sludge in multiple hearth and fluidized bed incinerators. PCB's and pesticides are, therefore, not expected to be emitted from the incinerator in sufficient quantity to adversely effect air quality.

A sewage treatment plant can also adversely effect air quality by generating noxious odors. Undesirable odors can occur anywhere wastewater or sludge is collected. The most prevalent odor associated with domestic sewage is hydrogen sulfide gas which smells like rotten eggs. Hydrogen sulfide is created by bacterial activity taking place in an anaerobic environment. All of the liquid unit processes at both proposed plants are designed to operate aerobically. If the treatment plant is properly operated and maintained there should be no problem with odors from these sources. Sludge processing can also create odors if not properly designed and operated. However, incineration at temperatures over 1,200°F is sufficient to destroy any odors.

Secondary adverse impacts on air quality by the proposed project will be minor. The principle pollutants emitted from increased urbanization are total suspended particulates (TSP) and sulfur dioxide (SO₂). However, the major source of residential emissions of TSP and SO₂ is home heating. Since very little of the population will be in the study area during the winter these emissions will be negligible. There are no industries associated with the project that would generate particulates or SO₂.

In order to assess the impact of increased human activity in the study area, carbon monoxide emissions from automobiles in Ocean City were analyzed. The details of the analysis are contained in Appendix B. The analysis concluded that the air quality impact of increased carbon monoxide emissions would not be significant in comparison to the appropriate standards.

6. Biology

Primary impacts upon the terrestrial environment induced by expansion of the Ocean City STP to 12 mgd would

be minimal because it would occur on relatively barren fill material. Expansion to 20.5 mgd would have adverse, long- and short-term, irreversible, primary impacts due to the destruction of 7.5 acres of salt marsh and bay bottom. Short-term effects include the destruction of salt marsh utilizing vertebrate and invertebrate species, discussed in Section II, and the destruction of all vegetation. Long-term effects include loss of animal habitat and reduction of total detritus supplied to the estuary, the latter being the primary source of energy for the estuarine ecosystem (Cooper, 1974). Quantitative estimates of short- and long-term impacts cannot be determined from existing data. Mitigating measures include the construction of an equivalent area of salt marsh in Isle of Wight Bay. Relocation of animals such as muskrats would also lessen impacts. No endangered species are known to utilize this marsh (DNR, 1977).

Construction of the mainland STP will have adverse, short- and long-term, irreversible primary impacts resulting from the clearing of 40 acres of woodland. Short-term impacts include the elimination from the site of two plant community types, two artificial ponds, associated wildlife habitat, and a certain quantity of wildlife. All herpetofauna, due to their migratory limitations, are expected to be destroyed. Effects upon bird and mammal communities will depend upon the species migratory ability, or the existing populations in surrounding areas, or both. Mortality is expected to be directly proportional to populations in adjoining areas. Although birds have no migratory capability limitations, competition for food and territory in surrounding areas for most species is expected to be intense. Small mammals (such as shrews, moles, chipmunks, etc.) are expected to have higher mortality rates than larger mammals (deer, fox, etc.) due to greater migratory limitations. Although this assumes that migration will occur, the latter cannot be assured.

Long-term impacts include reduction of the total amount of vegetation, animals, and habitat within the Basin. Wildlife impacts cannot be quantified due to the lack of existing data. Mitigating measures include the purchase and protection of a similar wooded area within the Basin, relocation of as many animal species as is practical, and construction schedules which allow maximum migration. No endangered species are known to inhabit this area (DNR, 1977).

Construction of pump stations, force mains, and interceptors, with the possible exception of the Herring Creek force main crossing, will have minimum impacts since they are located within highway and railroad rights-of-way,

residential lawns, or an extremely disturbed wooded plot. Impact of construction at the Herring Creek crossing will depend upon construction methods. If the force main is hung from the bridge, no adverse impacts should occur. If the force main is buried in the embankment, adverse, short-term, reversible impacts may result due to construction related problems such as erosion. Carefully designed and enforced construction method precautions would serve as mitigation. No endangered species are known to occur within any of these areas (DNR, 1977).

Outfall construction on the mainland will have adverse, short-term and long-term, reversible and irreversible impacts (All impact analyses assume a 100' wide construction zone [GMB, 1977]). Construction across grassland will have adverse, short-term, reversible impacts. Impact is expected to be minimal, short-term, and reversible since rhizomatous grasses are dominant and quickly inhabit abandoned, disturbed areas. Construction in the saltmeadow cordgrass community, harming about 0.2 acre, is expected to be adverse, short-term and reversible assuming original contours are reestablished. Impacts upon smooth cordgrass dominated marsh, with approximately 0.6 acre damaged, is expected to be adverse, short-term, and reversible, assuming original contours are reestablished after construction and the area is replanted with smooth cordgrass. Productivity, however, is expected to be reduced as a result of the removal, during construction, of nutrient rich peat. Restoration of a larger area of marsh would serve as mitigation. No endangered species are known to occur on the mainland side of the outfall route.

Outfall construction on Assateague Island will have adverse, short-term, reversible impacts upon vegetation assuming each plant community is replanted with its dominant perennial species, i.e., salt marsh grass in salt marshes and salt flats and American beachgrass in dunes. The presence on Assateague Island of Lechea maritima has been substantiated by Higgins et al., (1971). However, the presence of L. maritima var. virginica, currently on the Virginia list of endangered species and also being considered for endangered status by the State of Maryland and the U. S. Department of Interior, has not been confirmed (Broom, 1977).

Impacts of construction across Sinepuxent Bay and Assateague Island upon terrestrial fauna will be adverse, short- and long-term, and irreversible if construction occurs between March 15 and November 30. According to

Peregrine Falcon expert Dr. F. Prescott Ward (1977), the outfall area is "...one of the best spots on the island to observe and trap falcons..." The number of sightings made on the entire Island per year from 1970-1975 are: 68 in 1970, 120 in 1971, 39 in 1972, 136 in 1973, 59 in 1974, and 186 in 1975. The Spring migration period is not well documented but probably extends from April through May (Ward, 1977). Fall migration usually occurs between September 25 and October 15 (Ward, 1977). DNR (1977), however, recommends that no activity should occur between March 15 and May 15, and between September 1 and November 30.

"Because of limited human access, this area is not only attractive to falcons but also a wide variety of migratory and nesting shorebirds" (Ward, 1977). Anne Storey, a graduate student at the Institute of Animal Behavior at Rutgers University, found several pairs of nesting least terns, in June of 1975 and 1976, on the beach located east of the foredune. "The least terns occupy the beaches from early May through the summer... There are other marsh birds nesting west of the dunes and their breeding period roughly coincides with that of the least tern." On June 1, 1976, Storey observed the following on the north end of the island:

Nesting birds - 15 pairs least terns
5 pairs piping plovers
about 10 pairs of willets
2 pairs of killdeer

In flight or feeding:

7 Royal terns
4 gull-billed terns
4 glossy ibis
3 Skimmers
4 crows
2 laughing gulls

Although gulls and terns utilize islands in Sinepuxen' Bay for colony nesting, the nearest active nesting site is approximately 4,000 feet from the proposed outfall crossing (Brinker, 1977).

A herd of approximately 12 or 15 ponies utilize the northern portion of Assateague Island (Ward, 1977; Keiper, 1977). According to pony expert Dr. Ronald R. Keiper (1977), "spring and summer are periods when foaling occurs and young animals are being raised".

A freshwater pond is located south of the outfall path and is a source of drinking water for the ponies. Dr. Keiper states:

"Even if the waterhole is avoided, construction might still interfere with the movement of the ponies to and from this area. During the warmer periods of the year (April - November), the animals make 1 to 2 trips daily to these drinking sites, including the one in question. Often these walks take 15 minutes with the herd moving from the extreme northern tip of the island down to the waterhole in question. Construction might prevent the animals from moving freely to the drinking site or might even block the movement of the animals up and down the island. Likewise, the construction activity close to the waterhole may affect their behavior."

"I suspect that if the waterholes are avoided, if the work is done at seasons of the year when no critical reproductive activities are taking place, and if the movements of the herd up and down the island are not affected, then construction can take place without a significant effect on the ponies."

"I would expect, of course, that construction ditches would not be left uncovered or unguarded at times when workers were not present. The animals, as I've already suggested, move up and down the island in essentially a daily cycle, and would be susceptible to falling into an uncovered ditch. Such movement often occurs at night when the ponies have reduced visibility. In addition to the above precautions, I might suggest a gradual excavating process so that areas on both sides of the digging are left available for pony movement."

"In addition to the effect of the construction on the ponies, I am also concerned about such action on the island itself. I would hope that such construction would not have any permanent effect on the saltmarsh along the bay side of the island. The area of salt marsh is already reduced in size due to natural processes, these have been accelerated by the actions of man, yet this area is vital to the continued existence of the ponies since they graze extensively on these areas."

Impacts of construction upon terrestrial fauna between December 1 and March 15 are expected to be adverse, short-term, and reversible. The degree of adversity during this period, however, will be minimal due to the abundance of similar habitat on other sections of the island and the absence of migratory birds and nesting activities. This assumes, however, that construction is designed to allow daily pony migration and to prevent transportation of abnormal quantities of soil by wind. Construction through the surf zone will cause an initial loss of shoreline south of the crossing. However, this loss should be remedied after construction activities cease by the movement of sand accumulated on the northern side.

Secondary impacts upon the terrestrial environment in all suburban zoned areas will be severe, adverse, short- and long-term, and irreversible, assuming the selected alternative allows development to the full extent proposed in the future land use plan. All plant communities, with the exception of marshes due to their protection by COE under Section 404, are expected to be significantly disrupted or destroyed. The loss of animal habitat and animals from suburban zoned areas will, obviously, accompany the loss of plant communities. Of the animals affected, herpetofauna and small mammals (moles, shrews, etc.) are expected to suffer substantial losses due to their migratory restrictions. Destruction of larger mammals (deer, rabbit, etc.) in suburban zoned areas will depend upon the rate of development and population levels in surrounding areas. Although this assumes migration will occur, the latter cannot be assured. A reduction in the total number of bird species in suburban zoned areas is expected as a result of the reduction, or elimination, of existing habitat types and their being out-competed by the more aggressive suburban inhabiting forms such as starlings and house sparrows.

Reduction in the total number of herpetofauna and small mammals from the planning area, as a result of suburban development, is expected to be substantial. Reduction in the total number of large mammals (deer, rabbit, etc.) and birds in the planning area will depend upon present population levels in rural and agricultural zoned areas.

No secondary impacts upon endangered species are expected due to their presence in proposed conservation areas.

Primary impacts upon the aquatic environment resulting from the installation and operation of the applicant's proposed outfall will be adverse. Construction activities across Sinepuxent Bay will destroy benthic organisms and their habitats. Increased turbidity will affect some swimming organisms and their migratory patterns. Discharging sewage effluent into the ocean may adversely affect local biota through water quality degradation. These primary adverse impacts are short-term and reversible if construction is done during the winter months.

Drobeck et al., (1970) found 30 species of benthic invertebrates in the vicinity of the proposed Sinepuxent crossing (three 1-m² grabs at 2 stations). Animal density was 42/m² with the following composition:

Polychaeta worms	57.0%
Shrimp	13.0
Razor Clams	10.6
Brittle Star	9.1
Hermit Crabs	4.7
Spider Crabs	0.4
Hard Clam	0.4
Surf Clam	0.8
Blood Ark	0.8
Miscellaneous Species	2.8

No macrophytic algae were found at the two stations. The only locally harvested shellfish found in this area of Sinepuxent Bay is the hard clam (density = 1/6m²).

Sinepuxent Bay is approximately 250 m in length at the proposed crossing site. If the disturbed bay bottom is 30 m (100 ft.) wide, then the total area disturbed during construction will be 7,500 m². At an estimated animal density of 42/m², the total number of benthic organisms displaced will be 3.15×10^5 . Of this number, 1,260 will be hard clams (*Mercenaria mercenaria*). The majority of the disturbed animals will be polychaete worms. These estimates pertain only to the direct disruption resulting from construction in Sinepuxent Bay. The effects of increased sedimentation rates resulting from the site will probably be minimal since most of the organisms present can tolerate shifting sediments and turbid conditions.

Planktonic stages of benthic organisms in Sinepuxent Bay may be adversely affected by physical entrainment during dredging or by increased turbidity. This effect will be localized and could be mitigated by scheduling construction during the winter when planktonic populations are minimal.

Construction activity associated with burying the outfall across Sinepuxent Bay will probably have minimal impacts on presently low blue crab densities. There appears to be very little movement (migration) of blue crabs between Isle of Wight Bay and Sinepuxent Bay, and between these bays and the ocean through the Ocean City Inlet. Therefore, construction at the proposed site will not affect blue crab migrational patterns. If construction were completed during the winter there would be essentially no effect on blue crab populations because crabs are buried in the mud at locations remote from the outfall corridor.

The noise, turbidity, and equipment associated with pipeline construction could temporarily block fish movement between Sinepuxent Bay and the Atlantic Ocean. The small restricted areas of the proposed crossing would not allow fish to bypass the construction site. Spawning and feeding migrations may be severely disrupted if construction were attempted during migration periods. As a result, sport fisheries may be adversely affected during the construction year and in following years due to reproduction losses. Construction during the winter, the time of least migratory activity, should minimize these effects.

Boynton (1970) concluded that a localized increase in turbidity due to dredging operations in Chincoteague Bay would probably not have any noticeable effect on bay-wide primary production. This observation should also apply to dredging in Sinepuxent Bay. Local primary production losses could be minimized by winter construction.

A buried outfall in Sinepuxent Bay should not affect the local biota after construction has been completed.

Most adverse effects on benthic oceanic communities have been attributed to the discharge and accumulation of sludge, and toxic materials through ocean outfalls (Pike and Gameson, 1970). Three facts suggest that the oceanic benthic community will not be seriously affected by the proposed project:

- the proposed facilities will provide secondary treatment, and no sludge will be discharged;
- no significant sources of toxic materials are expected in the collection system; and,
- the existing Ocean City treatment plant has been discharging primary effluent into the ocean for eight years with no accumulation of sludge (Carter, 1976).

Filter-feeding benthic organisms may actually increase in numbers near the outfall due to the discharge of suspended organic material.

Currently there are no commercial shellfishing operations in the vicinity of the proposed outfall. Therefore, the required shellfish closure area around the outfall will not affect this industry.

The rock crab (Cancer irroratus) is the only commercially valuable crab species occurring in appreciable numbers in the nearshore oceanic environment of the study area (Casey, 1977, Personal Communication). These crabs only migrate close to shore during the winter, and harvests have increased in recent years. Outfall construction during the winter may destroy rock crabs that are unable to avoid the area, but this impact will be local and minimal.

Mobility should allow oceanic and estuarine fish to avoid the noise, turbidity, and equipment associated with outfall construction. Fish that normally forage for food in turbulent waters near the beach may actually benefit from the resuspension of food organisms during construction. Fish that prefer clear water may be temporarily displaced from the construction site; however, increases in turbidity above background should not be apparent beyond one mile from the area of active dredging. It is unlikely that fish movements into and out of Ocean City Inlet will be adversely affected by construction at the proposed location, particularly if construction is completed during the winter.

Berg (1975) concluded that nutrients discharged with domestic sewage appear to attract fish which, along with the phytoplankton that constitutes a part of the food chain, often thrive in such waters, but some species do disappear from such areas. The potential increase of fish production resulting from nutrient discharge from the proposed outfall can be estimated as one percent of the increase in phytoplankton biomass. At a design flow of 20.5 mgd, increased fish production may be 555 lbs/day (one percent of 5.55×10^4 lbs/day). This fish production, like the phytoplankton production, would be distributed over many miles of ocean.

Fin-rot has been observed in fishes caught around sewage outfalls in Florida and California. However, a direct cause-and-effect relationship could not be established since diseased fishes were also caught away from the outfalls (Berg, 1975). The existing ocean outfall in Ocean City has been discharging primary effluent for eight years without causing serious problems of fin-rot in local fishes. Whether or not problems of fin-rot will develop with the operation of another ocean outfall in the North Central Ocean Basin is difficult to predict. The lack of serious problems with the existing outfall and the dilution capabilities of the proposed diffuser suggest that fin-rot in local fishes will not result from the proposed project.

Little Gull Bank is situated approximately one mile from the end of the proposed outfall and is frequently fished by small-boat fishermen. This area is also the proposed site of an artificial reef-building project. The discharge of secondary effluent at the proposed site appears to be compatible with fishing activities. Water quality degradation should not occur over the reef as a result of the sewage discharge. Stimulatory effects of nutrient discharge may actually improve fishing in the area.

The physical disruption and destruction of sessile oceanic organisms are unavoidable primary adverse impacts of outfall construction. The lack of benthic invertebrate data for the area precludes the quantification of these effects. Commercially valuable shellfish such as the surf clam (Spisula solidissima) do inhabit the area but their densities are too low for profitable harvesting. Therefore, the severity of this impact is expected to be minimal. Similarly, the increased turbidity caused by construction activities are also expected to have minimal impact.

The destruction of planktonic stages of oceanic benthic organisms by physical entrainment during dredging and by localized turbidity increases can be minimized by winter construction. Recruitment possibilities of planktonic larvae from outside the affected area minimize the significance of larval destruction.

The nitrogen and phosphorus in the secondary effluent may stimulate primary production in the nutrient-poor waters of the ocean. The scale of enrichment for single ocean outfalls is probably too small and short-lived to cause plankton blooms (MacIntyre & Johnson, 1975). The potential increase in primary production (phytoplankton biomass) can be estimated at 13 lbs/gal of added nitrogen. At a design flow of 20.5 mgd, the total nitrogen load from the North Central Ocean Basin (4,270 lbs N/day, Table IV-1) could potentially increase primary production in the coastal zone by 5.55×10^4 lbs/day. This production would be distributed over many miles of ocean surface and may only appear as a slight increase (Pike & Gameson, 1970).

The proposed project utilizes ozonation as the disinfection method and eliminates potential damage to phytoplankton caused by chlorine residuals. Ozone residuals are probably more toxic to phytoplankton than chlorine residuals, but the rapid decay of ozone should limit the exposure time and reduce the total impact.

Local increases in oceanic turbidity during construction will have minimal impact on the primary productivity levels of the area.

7. Natural Resources

Construction and operation of the applicant's selected project would require the commitment of substantial quantities of natural resources. During construction, significant commitments of resources would include clay pipe along sewer routes, and concrete brick, wood and steel at the treatment plant sites and pumping stations. According to GMB (1977), a total of 40 acres of land would be committed as a result of the purchase of the West Ocean City STP site. An additional 7.5 acres of bay bottom and marsh would be required for expansion of the Ocean City STP. In addition, approximately 11,000 kwh/day of energy, 40-60 lbs/day of chemicals (mostly chlorine), and 51-62 man yrs/yr of labor (CEQ, 1977) would be required to operate both treatment plants. Approximately 9,500 cu. yards of concrete and 1,100 tons of steel would be required for construction of both plants (CEQ, 1977).

Secondary demands for natural resources would be much greater than the primary demands especially if "suburban" areas become fully developed. Principal resources required by secondary development are fuel, electricity, wood, brick, concrete, and labor.

8. Aesthetics

The applicant's selected plan would have both beneficial and adverse effects upon the aesthetic quality of the service area. A significant adverse, primary impact would result from the removal of vegetation at the proposed West Ocean City STP site and establishment of treatment facilities. A dense buffer zone of trees surrounding the site would mitigate this impact. During construction, noise generated by construction and transportation equipment would create adverse conditions. During construction, significantly higher noise levels would occur at both STP sites, highways along sewer line routes, some residential areas in West Ocean City, and along the ocean outfall corridor.

Operation of the proposed West Ocean City STP would increase noise levels in the immediate area. Operation of the expanded Ocean City STP is also expected to increase noise levels in its immediate vicinity. However, expanded treatment operations would not significantly increase noise levels in areas not adjacent to the plants. Pumping stations are completely enclosed and would not be significant sources of noise. Adverse visual aesthetic impacts induced by proposed pump stations would be minimal because they would be located in suburban or disturbed areas.

Increased traffic and traffic jams leading to, and within, Ocean City and Assateague Island State Park and National Seashore would have significant, adverse,

secondary impacts upon the present aesthetic quality of the area. The greater density of tourists in these areas, especially on the beaches, would also contribute significantly to aesthetic degradation. Increased boating would also significantly decrease the present aesthetic quality of the bays. A significant and severe, adverse, secondary impact would be the probable removal of all woodlands and cropland from suburban zone areas delineated in the future land use plan, and their replacement by residential and commercial buildings and roads. This would produce a drastic reduction in the present aesthetic amenities of these areas and increase aesthetic problems such as litter. Noises generated by secondary development would probably be similar to those associated with primary construction, but will occur over a much larger area.

Beneficial impacts of the applicant's selected plan would be substantial since it would improve stream and bay water quality and associated odors. Pumping stations along the collection system would be enclosed and air-tight, and would contain odor-control devices.

9. Recreation

The policy of Maryland's Coastal Zone Management Program is to "assure adequate public access and use of beach areas" and "to promote increased recreational opportunities in shoreland areas and increased public access to tidal waters in a manner which protects the quality of coastal resources and protects public health and safety."

Beach users will tolerate substantial crowding and the sand beach environment can support high use without severe environmental damage. Analysis of various standards have been made with application to Ocean City. The carrying capacity of the beach has been determined to range from a minimum of 31,000 to a maximum of 248,700 people/day. The standards applied were only recommended and do not constitute any official determination. Any number of people exceeding the maximum calculated carrying capacity (248,700 people/day) could produce a decline in the recreational experience. When this number of people is reached, it is possible that a "spillover" effect could take place causing greater stress on Assateague Island and Delaware beach usage.

Several projections done for Ocean City indicate a population higher than the calculated carrying capacity. It is difficult to determine at what point "overcrowding" will become a psychological/social deterrent to beach usage. Other factors such as restricted access and increased transportation cost could prove to be greater deterrents than beach overcrowding.

Roy Mann Associates, Inc. (1974) identified the following potentially problem causing factors associated with recreational boating:

- Rooted aquatic plants can be destroyed by the cutting action of boat propellers. Adverse changes in the biological productivity and habitat conditions may result where such actions occur.
- The wave energy generated from boats may accelerate shoreline erosion and increase turbidity. The severity of such effects depends on the shoreline soil, topographic conditions, vegetation characteristics and exposure to natural wave forces. The problem is most acute along narrow waterways or areas where boats pass close to shore.
- Resuspension of bottom sediments may result from the "prop wash" of propeller action. The resulting increase in turbidity can reduce primary production by resuspending nutrients. Toxic materials may be resuspended in the water column or "scrubbed" from the water column by the resuspended sediments.
- Wildlife and local residents may be affected by powerboat noise.
- Increased channel dredging and storage basin construction are often associated with boating and boating facility demands. Turbidity problems, circulation changes, and habitat destruction can result from dredging operations and spoil disposal.
- Docks, piers, bulkheads, breakwaters, bridges, causeways, etc, may induce changes in water quality when encroachment substantially restricts flushing and mixing of the waters in small enbayments, harbor areas, and inlets.
- Sanitary wastes from boats may cause public health problems. Refuse may add nutrients and pollutants to the water. Unsightly debris may float on open water or be washed up on shore, creating aesthetic problems.
- Paints which are used to inhibit the growth and encrustation of barnacles and other fouling organisms on pilings and boats, certain toxic substances, particularly copper, may be leached into the water.

- The effects of engine exhaust emissions have been the most extensively studied aspects of boating activities. There is, however, no clear consensus as to the severity of effects on water quality and aquatic life. The "worse case" condition for air and water pollution to be expected from boating activities in Mystic Harbour, Maryland, was calculated to be at least one order of magnitude below Federal air pollution standards (COE, 1976).
- Fuel and oil spillage may have localized adverse effects on biota in the vicinity of marinas and boat basins.

10. Archaeological and Historic Sites

No known archaeological or historic sites, designated by the Maryland Historic Trust or the National Register of Historic Places are expected to be impacted by primary construction activities.

One historic site, Fassitt House, is located within the suburban area designated in the future land use plan and may be affected by secondary development.

11. Flooding

The Ocean City STP is located in an area of special flood hazards with a 100-year flood elevation of 9 feet above mean sea level. The proposed expansion would also be located within the flood hazard area. The applicant has determined that the base elevation of fill required for expansion will be 12 feet above mean sea level (Figure IV-1). Placing the proposed treatment units at this elevation will be sufficient to protect them from damage during a 100-year flood.

A portion of the mainland STP site is located in a special flood hazard area. No designs for the facility have been prepared by GMB. As part of the Step 2 design of this facility, EPA will require the applicant to demonstrate compliance with EPA policy contained in Technical Bulletin EPA-430-99-74-001, Design Criteria for Mechanical, Electric and Fluid System and Component Reliability.

Secondary development occurring in the 100-year flood areas will be required to comply with Worcester County ordinances being prepared in compliance with the National Flood Insurance Program.

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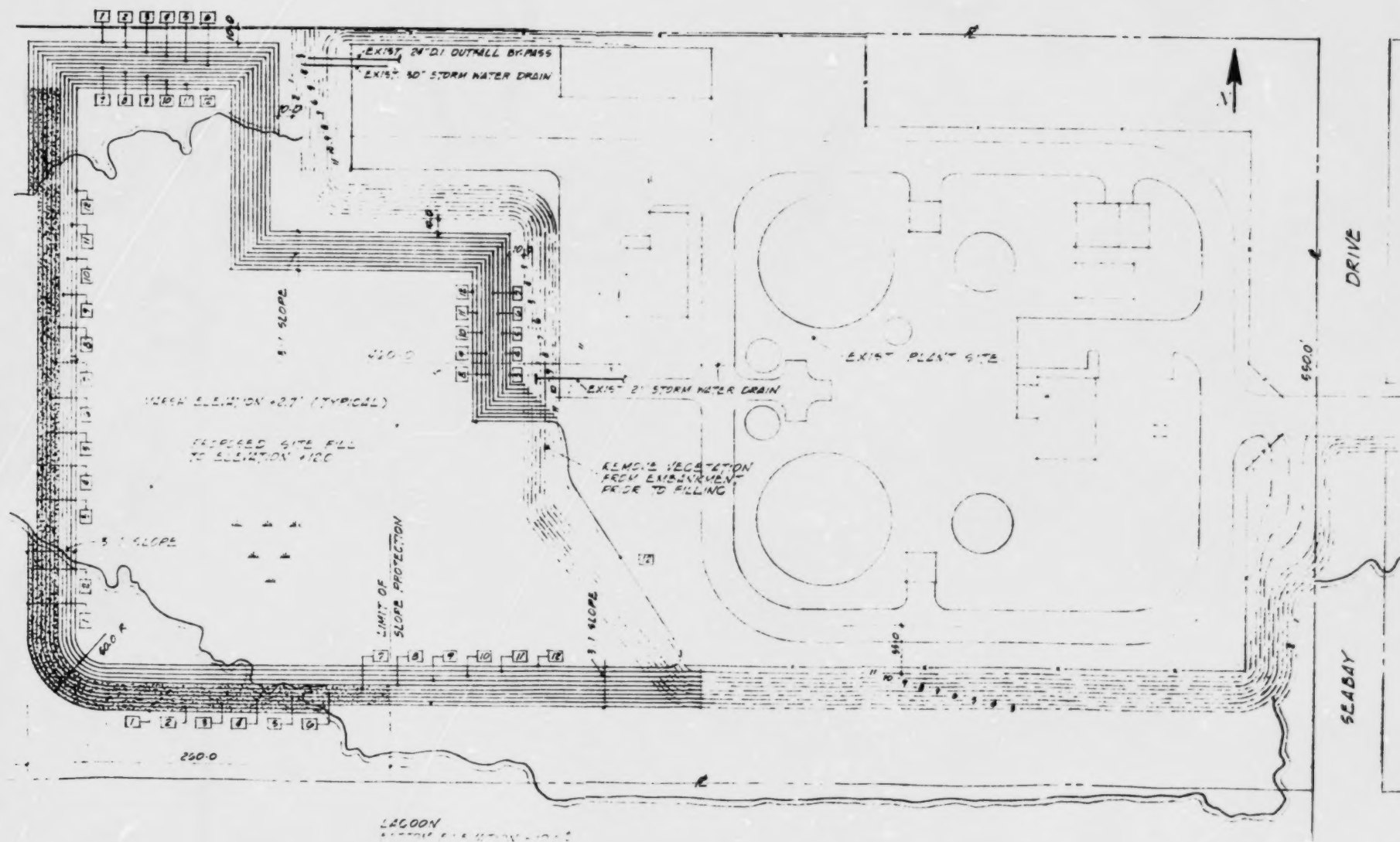


FIGURE IV-1. AREA AND ELEVATION OF THE EXISTING AND PROPOSED EXPANSION OF THE OCEAN CITY SEWAGE TREATMENT PLANT.

12. Public Health

A primary goal of the proposed project is the improvement of public health in the study area for current and future residents. Public health nuisances in the study area include malfunctioning septic tanks and small sewage treatment facilities. WCSC designated these nuisances the primary targets for elimination by the proposed project. All other impacts beneficial or adverse, result from the initiation of the proposed project to improve public health.

Elimination of septic tanks and small sewage treatment facilities will protect citizens of the area against contracting enteric diseases through direct contact with surface waters contaminated with sewage effluent or through drinking contaminated groundwater. Reliance upon septic tanks by an increasing population in the study area would substantially increase the probability of spreading enteric diseases, especially through groundwater contamination. Improvement in surface water quality may be sufficient to permit shellfishing in some areas which are presently closed because of effluent contamination or nonpoint source runoff.

Secondary public health impacts may occur with increased recreational boating activity in the inland bays. Previous studies of the Miles River along the eastern shore of the Chesapeake Bay have determined that a slight increase in coliforms occurred with the congregation of pleasure yachts (DNR, 1976). Other studies have concluded that the following results may result from the overboard disposal of sanitary wastes (DNR, 1976):

- In a 1971 study of Great South Bay off the south shore of Long Island, it was concluded that during the peak Labor Day period, coliforms entrained by clams were in excess of standards imposed by the New York State Department of Environmental Conservation.
- Bacteriological quality of two bays in the State of Washington was degraded with the introduction of small boat wastes.

13. Social and Economic Impacts

The applicant's proposed project will have several social and economic impacts upon the North Central Ocean Basin. Primary impacts will result from the requirement for revenue to finance the capital and operation and maintenance costs of the project, and the required closure of shellfishing areas in the Atlantic Ocean. Secondary impacts will include the enhancement of property values in the service area; the requirement for investments in other public services; and the alteration of the Basin's social and economic structure.

The cost of constructing the Mainland STP and expanding the Ocean City STP represents a primary impact of the proposed project upon the economy of Worcester County. Assuming that the Town of Berlin connects to the regional system, the initial Phase I cost for the proposed project will be approximately \$29.9 million. However, if the proposed project or a modification of the project is approved by EPA, the Federal Government will provide 75 percent of eligible project costs as authorized by PL 92-500 (Table IV-4.) In addition to the federal grant, the State of Maryland is authorized to award grants equal to 12.5 percent of eligible capital project costs. Costs not covered by federal and state grants must be born by WCSC. GMB (1977) assumed that WCSC's share of Phase I and II project costs would be financed by a revenue bond issue.

Table IV-4. Estimated Project Costs, Federal and State Grants and Bond Issue Requirements for Phases I and II Construction and Expansion of the 8.9 mgd Mainland STP and 20.5 mgd Ocean City STP. [Source: GMB (1977)].

<u>OCEAN CITY STP</u>			
	<u>Federal Share</u>	<u>State Share</u>	<u>Local Share (Bond Issue Requirements)</u>
Phase I	\$13,663,875	\$2,277,312	\$2,277,312
Phase II	<u>7,305,675</u>	<u>1,217,612</u>	<u>1,217,612</u>
TOTAL	\$20,969,550	\$3,494,924	\$3,494,924
<u>MAINLAND STP</u>			
	<u>Federal Share</u>	<u>State Share</u>	<u>Local Share (Bond Issue Requirements)</u>
Phase I	\$ 8,763,000	\$1,460,500	\$1,460,500
Phase II	<u>2,049,375</u>	<u>683,125</u>	<u>683,125</u>
TOTAL	\$10,812,375	\$2,143,625	\$2,143,625

Bond amortization for the local share of project costs will be accomplished by assessment of annual front-foot and/or lump-sum connection charges against users and beneficiaries of the wastewater treatment facilities.

Funds required for operation and maintenance (O&M) of the systems will be secured from quarterly service charges levied against all users of the system. These charges will be apportioned on water use or a plumbing-fixture charge (GMB, 1977). Estimated front-foot and user charges for various sewer service areas is presented in Tables IV-5. Initial annual operating costs based upon present prices for the recommended facilities have been estimated to be \$989,900 (GMB, 1977).

An Industrial Cost Recovery (ICR) program will be developed, if necessary, for recovery of capital and O&M costs from any significant industrial users of the system.

Items which will not be funded by either EPA or the State of Maryland include land for treatment plants and local collection systems not complying with the federal "two-thirds rule" regarding existence of dwellings prior to October, 1972. Local collection for individual service areas will be paid directly by the area being served through the assessment of a connection fee.

The current costs imposed by the Worcester County Sanitary Commission on Ocean City are:

Connection	Basic \$450 charge can be greater according to diameter of pipe being connected.
Permit Fee	For new construction requires plumbing permit - \$5 plus: <100 fixtures @ 50¢/fixture >100 fixtures @ 25¢/fixture
O&M Charges	\$5.00/fixture/year (domestic) \$10.00/fixture/year (commercial)
Bond Amortization	Front Foot Rate - 65¢/front foot Exceptions: condominiums - minimum 18 feet/year.

Harvesting and/or holding shellfish will be permanently restricted from a buffer zone around the proposed outfall crossing Assateague Island. The area of the closure zone will be determined by DHMH and will be sufficient to protect the public from severe contamination if the sewage treatment plant should fail to operate properly. The closure of this area will be a minimal impact upon shell-fishing in the area.

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Table IV-5 . Estimated Average Individual Sewer User Charges for the Mainland STP
[Source: GMB (1977)].

<u>YEAR-1980</u>					
<u>Proposed Service Area</u>	<u>Local Collection</u>	<u>Regional Collection</u>	<u>Regional Treatment</u>	<u>Regional Disposal</u>	<u>Total</u>
West Ocean City	\$68.91	\$ 10.42	\$ 46.37	\$ 9.89	\$ 135.59
Sinepuxent Neck	N/A	3.91	46.37	9.89	60.17+
U. S. 50	N/A	14.06	46.37	9.89	70.32+
Berlin	N/A	21.45	46.37	9.89	77.71+
Chesapeake Foods	N/A	195,360.00	92,470.00	19,780.00	307,610.00
Ocean Pines	36.00	33.62	46.37	9.89	125.88
Isle of Wight	N/A	DEVELOPMENT IN 1985	-	-	-
<u>YEAR-1990</u>					
West Ocean City	\$55.70	\$ 5.53	\$ 38.47	\$ 5.87	\$ 105.57
Sinepuxent Neck	N/A	1.77	38.47	5.87	46.11+
U. S. 50	N/A	9.18	38.47	5.87	53.52+
Berlin	N/A	12.82	38.47	5.87	57.16+
Chesapeake Foods	N/A	110,870.00	76,940.00	11,560.00	190,370.00+
Ocean Pines	36.00	15.90	38.47	5.87	92.04+
Isle of Wight	N/A	47.70	38.47	5.87	92.04+
<u>YEAR-2000</u>					
West Ocean City	\$53.04	\$ 3.89	\$ 21.46	\$ 3.65	\$ 82.04
Sinepuxent Neck	N/A	.92	21.46	3.65	26.03+
U. S. 50	N/A	6.07	21.46	3.65	31.18+
Berlin	N/A	9.08	21.46	3.65	34.19+
Chesapeake Foods	N/A	76,240.00	42,920.00	7,300.00	126,460.00+
Ocean Pines	36.00	10.20	21.46	3.65	71.31
Isle of Wight	N/A	21.88	21.46	3.65	46.99+

Numerous large tracts of land would be made available for development as a result of the applicant's proposed project (Figure IV-2; Table IV-6). Most of these properties occur along the Route 611 corridor. Except for the tract owned by the Adkin's Company (#6), all of the properties are within the proposed sewer service area, which implies that they are in compliance with the future land use plan. Development of these tracts has been restricted because sewerage was not available. The provision of sewerage will permit the development of these tracts at sufficient densities to provide profit to their developers. In addition, to these large tracts, numerous small land holdings will become available for subdivision.

The impact of this secondary development may be beneficial or adverse depending upon growth management proposed by Worcester County.

A major public investment in highway alterations will be required to support the continued use of Ocean City and the North Central Ocean Basin by large populations of weekend tourists. This problem became severe in the early summer of 1977. The Maryland State Highway Administration (SHA) has determined that alterations of existing highways are required at Cambridge, Vienna, Kent Narrows, and Denton, Maryland. The first three sites are problems because 4-lane highways are funneled on to 2-lane bridges. Alterations at these sites, especially at Cambridge and Vienna, would require significant disruption of wetlands. Alterations at Kent Narrows would involve disruption of some wetlands and a large marina. SHA proposed that the total cost of these alterations could approach \$200 million and that work on the projects probably would not begin before 1982 (Maraniss, 1977). Relief of congestion at these sites may not relieve traffic flow on the Eastern Shore, but rather shift congestion to other sites. Potential congestion sites could include areas of Route 50 within the cities of Salisbury, Cambridge, and Easton, the junction of Routes 50 and 404, and the Chesapeake Bay Bridge.

Buses are the only form of mass transportation serving the North Central Ocean Basin. Rail service on the Eastern Shore is limited to freight service. If rail service were provided to the Basin, trains from Washington and Baltimore would have to travel north into Delaware, cross the Chesapeake and Delaware Canal at Summit, and traverse the length of Delaware to Salisbury, Maryland.

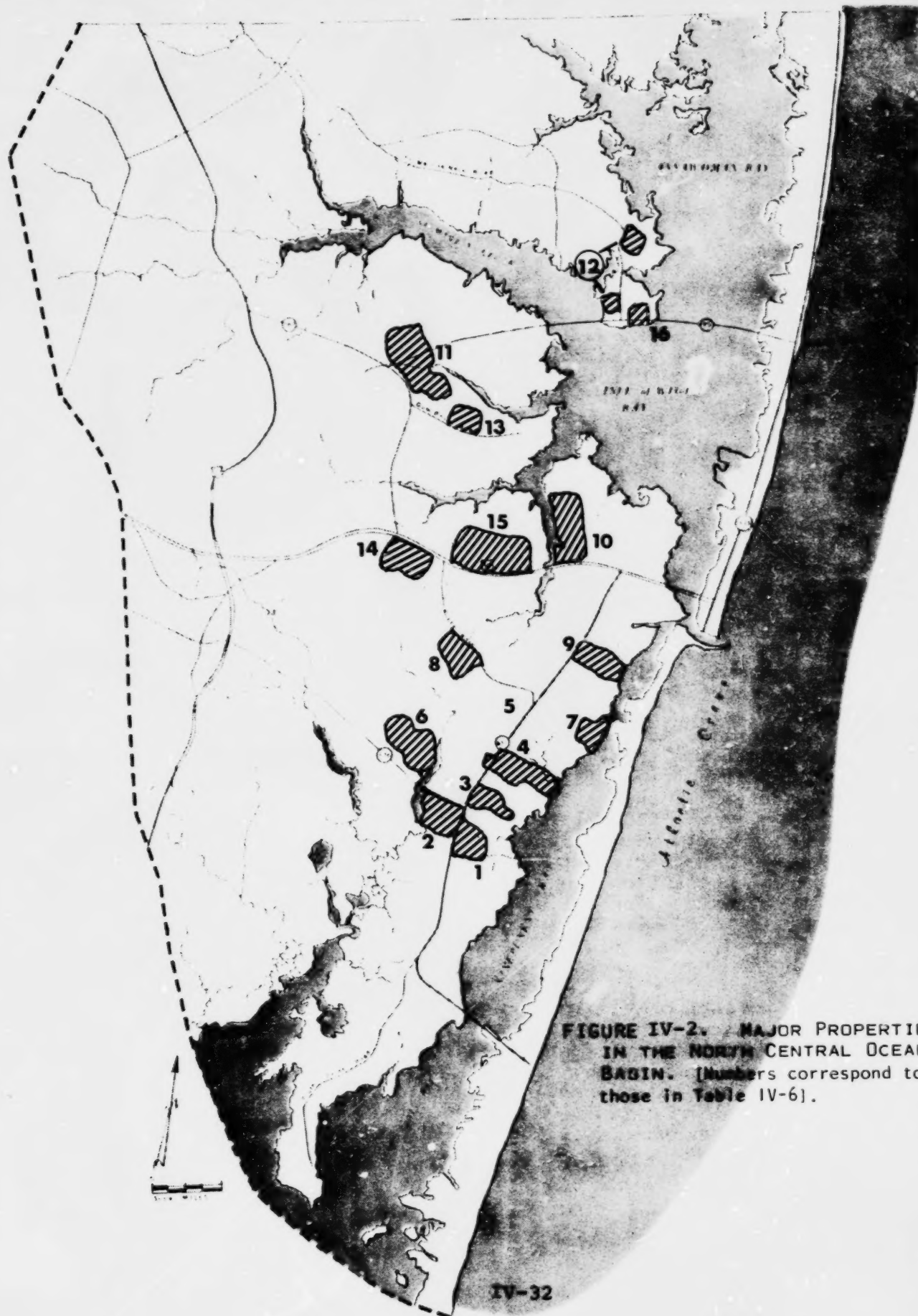


Table IV-6. Owners and Areas of Major Properties Identified In or Near the Proposed Sewer Service Area. (Numbers correspond to those in Figure IV-1)

	<u>OWNER</u>	<u>AREA (Acres)</u>
1	Assateague Joint Venture, Inc.	86
2	Decatur Development Corporation	167
3	Parkel Corporation (Frontier Town)	121
4	Bayside Properties	140
5	Atlantco Limited Partnership	144
6	Adkins Company	319
7	Mayor & City Council of Ocean City	230
8	Third World Development Corporation	70
9	Mystic Harbor Development Corporation	143
10	Sea Isle Investments, Ltd. Partnership	78
11	Boise Cascade Home & Land Corporation	
12	Wm. R. Bloxom	51 (Island)
	Montego Bay Development	716 (Mainland)
13	Harbor View Limited Partnership	133
14	Atlantco Limited Partnership	95
15	Fidelity/Philadelphia Trust Co. Trustees	995
16	J. Thomas Requard	449

Continued traffic congestion and possible rising costs of automobile travel may begin to decrease the number of weekend tourists to the Basin. In order to attract tourists, convenient forms of mass transportation may be required.

Numerous secondary fiscal and social impacts could occur with the accommodation of secondary/recreational home development and increased recreational use of the North Central Ocean Basin. The following possible economic impacts have been identified by ASPO (1976).

Recreational land development can stimulate local economies through increased tax revenues and developer and consumer spending.

Net fiscal impacts on local government are positive in the first few years of most developments. The increase in tax revenues generated by development usually exceeds the increased cost of providing public services because:

- Most recreational subdivisions initially have few homes built in them, and therefore, do not make major public-service demands on local governments.
- Second homes are taxed at the same rate as first homes, but most second homes are occupied seasonally. Seasonal populations place few burdens on local public school systems, which generally consume as much as half or more of local tax revenues.
- Some local governments either ignore many of the service demands of second home owners, or do not have the capacity to provide them. Consequently, many recreational subdivisions are not provided the services which would normally be expected in suburban developments of similar size and density.

Negative fiscal impacts can result from recreational land development if public service demands or major capital expenditures necessitated by these projects exceed the tax revenues they generate. This can occur when:

- substantial permanent occupancy by families with school-age children occurs in recreational subdivisions.

- development necessitates major, unexpected capital expenditures by local governments, such as improving an access road to a project, or expanding a sewage treatment plant to facilitate a new recreational subdivision.
- recreational subdivisions are sparsely populated, and the costs of providing public services to a few residences exceeds the total tax revenues generated by these projects.

Communities have attempted to reduce negative fiscal impacts by various methods:

- Standard facilities requirements (commonly used with conventional subdivisions) for roads, water supply, and sewage disposal systems have usually been successful in reducing subsequent public investments for such facilities.
- Privately-owned and maintained facilities (usually by property owners associations) have relieved public responsibility for future maintenance and operation. However, this approach can become a problem if property owners associations collapse and local government must accept their responsibilities.
- Restricting permanent occupancy, but experience to date indicates that this approach is administratively impractical and difficult to enforce.

The impacts of recreational land development on the private economic sector can be both positive and negative.

- A major benefit is the increase in community income which occurs to the extent that expenditures made by developers and property owners are made in the local economy. Between one-third and three-fourths of the total development and user expenditures may accrue to the local area, depending primarily on the levels of project improvements and amenities, the extent of home construction and occupancy, and the availability of goods and services in the local community. Unimproved subdivisions generate relatively little community income in comparison to improved second-home projects and resort communities because development activity, home construction, and occupancy are minimal.

- New job opportunities may also be created, either directly in the construction and operation of projects, or indirectly in local businesses serving projects and their residents. At the same time, some old jobs, usually agriculturally related, may be displaced.
- In some communities, the creation of new jobs from recreational land development has attracted job seekers from outside the local area, creating competition for the new jobs which are available, and also generating secondary population growth for which public services must be provided by local government.
- Recreational land development has created markets for the sale of marginal farm, grazing, and timber lands in many parts of the country. On the other hand, development has increased land values, housing costs, and tax assessments pricing some native rural families out of farming and local housing markets.

The following social impacts could occur as a result of increased second home development (ASPO, 1976):

As home construction and occupancy in recreational subdivisions occurs, traditional rural cultures and lifestyles change. Service-oriented tourist businesses replace farms and woodlands as subdivisions and second homes develop. These social changes are accentuated by the fact that the newcomers are generally urbanites with attitudes and lifestyles contrasting significantly to those found in most rural communities. Local attitudes toward these social changes vary widely.

- Some local residents view recreational land development and its resulting population growth as a cultural as well as an economic asset. They welcome the stimulus of change - the influx of new people with lifestyles and attitudes different from their own.
- Others regret the gradual erosion of traditional rural culture, but accept it as the inevitable price of economic growth.
- Still others consider recreational land development a form of exploitation and colonization by a wealthier urban class. In some parts of the country where second home development has been extensive, local residents strongly resent the countryside becoming a vacation suburb for middle-income families from the cities.

Other social impacts which have concerned local residents are increased crowding and traffic, increased crime, and restricted access to public recreational facilities.

Recreational property owners may become important political forces in rural communities, depending largely upon their occupancy patterns.

- Families using their second homes seasonally rarely become involved in local community affairs. Second home developments have been called "communities of limited liability" where residents come to rest and relax, taking little interest in local rural problems which do not directly affect them.
- When recreational land development results in permanent population growth, the political effects can be substantial in sparsely populated rural areas. The tendency for these newcomers to take an active part in local affairs is accentuated by the fact that they generally have higher educations, higher incomes, and more free time than the previous local residents.

Many second-home owners share a common attitude referred to by some as the "gangplank syndrome." Having moved to an area to enjoy its natural beauty and rural atmosphere, they are anxious to keep it that way, and attempt to close the area to further growth. In rural communities opposed to more recreational development, these individuals have often been instrumental in shaping local growth policies. In other cases, especially where local residents still wish to capitalize on land development, this "we've got our" attitude of some second-home owners is deeply resented.

Consumer victimization in recreational land sales has been a serious national issue for more than 10 years, and remains an important social issue. Thousands of consumers have been the victims of high-pressure sales tactics, deceptive and fraudulent advertising practices, and broken promises.

- Consumer victimization has been far more widespread and serious in the unimproved-lot sales business than in other sectors of this industry.
- During 1973 at the peak of the recreational land development boom, HUD received 1,500 letters per month from consumers, more than half of which were complaints against land sales firms. Most consumers complained about the failure of developers to deliver promised improvements, deceptive sales practices, and the poor investment potential of the property.

- Many recreational lot buyers have been dissatisfied with their purchases. Some surveys have reported that as many as half of the responding lot buyers were disappointed.
- The investment potential of many unimproved recreational lots has been poor, partly due to the fact that the original lot prices were substantially inflated with sales and promotion costs. Resale experiences have been dismal for many consumers, and some have failed even to recoup their original investments.

14. Land Use Impacts

The applicant's proposed project will have several impacts upon land use in the study area. The primary impact will result from utilization of the selected site (40 acres) for a wastewater treatment plant. Secondary impacts will result from development of currently vacant land in response to the availability of sewage treatment capacity.

Use of the selected site for a sewage treatment plant will preclude its possible use for other purposes. The site is currently zoned as an A-1 District for agricultural uses. The site is entirely forested. The A-1 classification allows for the construction of sewage treatment facilities but is considered a conditioned use which requires approval by the Worcester County Board of Appeals.

The applicant's proposed project will provide sewage treatment capacity for future development in the study area. Investments in wastewater treatment and conveyance facilities have been identified as having impacts on the location, rate, and character of local growth (EPA, 1975). Any growth which is accommodated or induced by such facilities will generate environmental impacts which should be considered as related to the investment. These impacts from growth may be physical (increased nonpoint pollution from runoff), economic (employment and tax effects), or social (changes in local aesthetics or cultural values). "Accommodated growth" is previously projected population increases which will be accommodated by the proposed sewage treatment facility. "Induced growth" is that portion of the total population increase attracted to a particular service area from neighboring areas within the same economic region. The North Central Ocean Basin contains no major land markets from which the sewer service areas could induce growth. Therefore, all future development within the service area is projected to be accommodated growth.

Seven specific sewer service areas were delineated by GMB (1977). Three of these areas currently have sewer service. The amount of excess treatment capacity available for each one of these areas is summarized in Table IV-7.

Table IV-7. Reserve Capacity at Existing Sewage Treatment Facilities
in the North Central Ocean Basin.

<u>Service Area</u>	<u>Current STP Average Flow</u>	<u>Design Flow</u>	<u>Number of Additional People Which Can Be Served</u>
Ocean City	(1.4 mgd)*-(7 mgd)**	12 mgd	50,000
Ocean Pines	(0.1 mgd)*-(0.4 mgd)**	1 mgd	6,000
Berlin	0.24	0.6 mgd	3,600

To determine the number of additional people which will be "accommodated" by the applicant's proposed project, it was first necessary to determine what number of people could be served by existing treatment plants and on-site disposal systems. This was accomplished through a "vacant land suitability analysis" and is part of the "no-action" alternative (Section V B 4).

Reductions in the service area's ability to absorb new growth could occur as part of the "no-action" alternative (continued reliance on on-site disposal). Table IV-8 summarizes projected populations, vacant developable land, and ultimate residential population capacities at future planned residential densities with or without the proposed sewerage facilities. These estimates were based on the following assumptions:

- Coastal marshes indicated by MSDP in the 1973 Land Use Map will have limited future development;
- Assateague Island will not be developed as a result of its park designation;
- Beaches will not be developed;
- Soils unsuitable for septic tanks will generally not have any additional development of on-site waste disposal systems;
- No septic systems will be permitted in Ocean Pines, Berlin, or Ocean City for additional development;

Table IV-8. Projected Populations and Ultimate Population Capacities in the North Central Ocean Basin.

	For Applicant's Proposed Sewer Service Areas		Entire North Central Ocean Basin
• Vacant Land Suitable For Septic Tanks (acres)	2244		13,121
• Population Capacity with existing sewerage facilities	136,000		136,000
	*Ocean City	120,000	
	Berlin	6,000	
	Ocean Pines	10,000	
• Population Capacity with applicants proposed sewerage improvements	*294,000		343,108
• Future Population Capacity with Septic tanks [No-action]	9,551		49,108
• Projected Total Popula- tion Change 1975-2000 (Includes seasonal and year-round population)	*202,890		239,430

*Assumes 100 gpcd for Ocean City Service Area

- No substantial redevelopment for residential uses (all future residential development will occur on currently vacant lands);
- Family size in the Basin will remain constant (3.1 persons);
- Densities of residential development (Dwelling Unit/net acre-DU/NA) will occur according to the 1976 Comprehensive Plan with the exception of the Suburban classification. This category assumes that sewer service will be available to support 10 DU/NA. For purposes of the "no action" analysis, the density for this category was considered as Rural;
- All densities of residential development inherently consider concomitant land uses such as educational, commercial, public services, etc.;
- Approximately 25 percent of low density residential spillover would occur in areas unsuitable for development (poor soils, wetlands, etc.)

To determine the amount of growth that the entire sewer service area could absorb, the population capacity with existing sewerage facilities plus the population capacity which could be accommodated by septic tanks was calculated. Subtracting this total from the projected population increases for the service area provided an estimate of the total growth which would be accommodated by the project. This figure was determined to be 57,000 people.

Applying this technique to the entire Basin, the figure is 54,300. This number is slightly lower than that for the service area because of the greater capacity for septic tank development in areas outside the proposed sewer service area.

Continued reliance upon septic tanks would impose severe restrictions on expected growth in Ocean City. Because the town does not permit the use of septic tanks anywhere within its limits, expected growth could not be accommodated without provision of treatment capacity by WCSC. Total accommodated growth in the town was calculated to be 85,000 people.

Ocean Pines currently has complete sewer service to all of its development. The Ocean Pines STP has a capacity of 1 mgd with an NPDES permit to expand to 4 mgd. All future growth within this area could be accommodated by existing systems. Therefore, the no-action alternative would impose no restrictions on future development within Ocean Pines.

Berlin's STP has a maximum capacity of 0.6 mgd with average flows of 0.24 mgd. Assuming that all available capacity could be devoted to residential growth, the system could accommodate an additional 4,000 people.

New development has been hindered in regions outside of existing service areas due to the lack of sewerage facilities. The State of Maryland has adopted a policy restricting additional waste discharges into the coastal bays. This has restricted the use of package treatment plants for subdivisions. Mystic Harbour recently closed partly because its land disposal wastewater system failed and public sewerage facilities were not available.

Vacant land availability is high within the sewer service area. Due to its proximity to the coastal bays, the Atlantic Ocean, Ocean City and other coastal amenities, the service area has a potentially high value and demand. Also, the amount of sewer service outside the proposed service area within Worcester County is low. Only two towns, Snow Hill and Pocomoke City, provide additional sewer service. Neither town offers the aesthetic and recreational amenities that are provided by the North Central Ocean Basin. Active land speculation has occurred within the service area and has resulted in ownership of large parcels of land by development corporations. It is estimated that once sewer service becomes available, extensive recreational, second home development will occur. Sewers typically have their greatest impact on the construction of single family homes, and these are most likely to be built where there are large tracts of available, undeveloped land (ASPO, 1976).

If sewers serve extensive amounts of vacant land, particularly when the individual parcels are large, the resulting development is usually low density (ASPO, 1976).

The following potential land use secondary impacts have been identified by EPA (1975) for most wastewater treatment projects:

- The increased attractiveness of sewerred areas encourages land speculation and increases real estate values. Although it is difficult to isolate these sewer-related increases, a doubling in value appears normal, while three-, four-, and five-fold increases in value are not exceptional. EPA has identified large property holders in the service area which could gain "windfall" profit as a direct result of the proposed project (Figure IV-2, Table IV-6).
- Sewer-inspired development is often of the dispersed sprawl type with deleterious effects on available public services to residents of the newly developed areas, on per capita public services in the region as a whole, and/or on tax burdens to residents of other areas in the region.
- A potential physical effect of sewerage investments is decreased water quality through storm water runoff in newly developed areas.
- Interceptor sewers servicing undeveloped or partially developed land areas subsidize developers by providing relatively low cost sewage treatment. The subsidy encourages moderately-priced housing, as opposed to higher-priced housing in unsewered areas.
- New sewers increase the density of possible development and thus the potential economic "rent" (and development profit) per unit of land to the owner or developer.

- New sewerage is often partially financed by revenue bonds to be repaid through connection and service charges. Local authorities tend to encourage connections through easy rezoning in order to stimulate revenues while the market is strong.

B. Adverse Impacts Which Cannot Be Avoided

The applicant's proposed plan will produce many adverse environmental impacts. Although the consequences of this project are intended to be strictly desirable, some of the adverse impacts which will occur cannot be avoided. However, many of these impacts can be minimized or mitigated through careful planning and enforcement of regulations designed to protect environmental quality. An assessment of unavoidable environmental impacts resulting from the proposed plan is summarized in Table IV-9. Impacts are characterized as "primary" or "secondary" and "short-term" or "long-term". The degree of impact has also been projected. The decisions listed in Table IV-9 were formulated after extensive analyses and include both environmental, social, and engineering considerations. Mitigating measures to reduce adverse impacts are also included.

C. Relationship Between Local Short-Term Use of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The applicant's proposed project would reduce current environmental degradation and public health hazards and provide facilities for the enhancement of the long-term growth and development of the resort of Ocean City. The cost of the proposed project and its short-and long-term environmental consequences are not completely justified by its beneficial impacts.

The North Central Ocean Basin has a rapidly developing tourist industry. Agriculture and commercial fishing are declining in economic importance. The proposed project is an integral component of a land use plan which supports the continued development of the tourist industry and also attempts to preserve agricultural areas. However, the proposed project does not provide Worcester County with a tangible mechanism for directing orderly growth and development in the service area. A major component of the proposed collection system, designed to eliminate a properly-functioning AWT facility, would also open a large sparsely developed area to random and uncontrolled growth. As a result of secondary development in the service area, nonpoint source pollution loads to the coastal bays will potentially exceed current total pollution loads. This constitutes a long-term environmental degradation and conflicts with state, local, and project goals of improving water quality in these bays.

Table IV-9. Unavoidable Adverse Impacts of the Applicant's Proposed Project

<u>Parameter Impacted</u>	<u>Impacting Action</u>	<u>Type and Degree of Impact</u>	<u>Mitigating Measures</u>
Surface Water Quality	Increased nutrient loading of the near-shore ocean by sewage effluent	Primary, long-term, minimal	Advanced wastewater treatment or land application of effluent
	Increased BOD loading of the coastal bays from suburban development	Secondary, long-term, significant	Stormwater control and retention
	Increased erosion and sedimentation	Primary, short-term, minimal Secondary, long-term, moderate	Strict enforcement of state and local erosion and sediment control ordinances
Surface Water Flow	Increased flooding of small streams from suburban development	Secondary, long-term, minimal to locally significant	
Water Supply	Increased demand for potable water	Secondary, long-term significant	Development of a comprehensive water supply program for the entire basin based upon a single estimate of future population and available water

Table IV-9. (Continued)

<u>Parameter Impacted</u>	<u>Impacting Action</u>	<u>Type and Degree of Impact</u>	<u>Mitigating Measures</u>
Air Quality	Incineration of increased volumes of sewage sludge	Primary, long-term, minimal	Enforcement of Federal and state emissions standards; land application of all sludge
	Increased air pollution emissions from automobiles	Secondary, long-term, minimal	Enforcement of air quality maintenance programs, provision of mass transit facilities
Biology	Destruction of 7.5 acres of wetland at the Ocean City STP	Primary, long-term, minimal	Expansion of the facility at another site
	Destruction of vegetation at the Mainland STP site	Primary, long-term, minimal	Construction of the facility at another site
	Disruption of the outfall corridor across Assateague Island	Primary, long-term, minimal	Strict use of environmentally sound construction techniques
Natural Resources	Construction and operation of the proposed treatment facilities	Primary, long-term, minimal	Efficient use of resources committed to wastewater treatment and disposal
	Construction of secondary development	Secondary, long-term, minimal	Efficient use of resources; increasing prices for construction materials

Table IV-9. (Continued)

<u>Parameter Impacted</u>	<u>Impacting Action</u>	<u>Type and Degree of Impact</u>	<u>Mitigating Measures</u>
Aesthetics (Noise)	Construction and operation of the sewage treatment facilities	Primary, long-term minimal to locally significant	Enforcement of local noise control ordinances
	Construction of secondary development	Secondary, long-term, minimal to locally significant	
Aesthetics (Odors)	Potential odors from the sewage treatment facilities	Primary, long-term, minimal to locally significant	Proper operation of unit processes; use of odor control devices
Recreation	Destruction of the recreational potential of the Mainland STP site	Primary, long-term, minimal	Location of the treatment facility at another site
	Increased demand for currently strained recreational resources	Secondary, long-term, significant	Development of new recreational sites

Table IV-9. (Continued)

<u>Parameter Impacted</u>	<u>Impacting Action</u>	<u>Type and Degree of Impact</u>	<u>Mitigating Measures</u>
Economic and Social Factors	High capital costs of the proposed facilities	Primary, long-term, minimal to locally significant	Selection of the most cost-effective system and component alternatives; federal and state funding of eligible costs
	Closure of areas of the near-shore ocean to shellfishing	Primary, long-term, minimal	Land application of effluent
Land Use	Inducement of secondary growth beyond the carrying capacity of the service area	Secondary, long-term, potentially significant	Reduction of treatment capacity; phasing of collection and treatment facilities; strict enforcement of land use plans and zoning ordinances

The capacity of the proposed treatment plants and the collection system has been designed to accommodate projected growth in the service area. However, the proposed capacity requirements may maximize costs to the current population by requiring expensive investments based upon currently projected development which may not occur. Phasing of the treatment facilities will partially mitigate the economic demands of the proposed project and maximize the efficiency of public investments. Growth projections for the service area were completed before recent awareness of the national "energy crisis". The long-term effects of that crisis and of increasing gasoline prices upon the growth of tourist populations in the North Central Ocean Basin have not been assessed. However, other components of the infrastructure supporting the tourist industry are currently being stressed. Weekend automobile travel on the Eastern Shore has become extremely difficult. The major highways serving Ocean City are approaching their capacities. Relief of this situation has been estimated to cost \$200 million. This cost is in addition to the cost of constructing the second Chesapeake Bay Bridge, which was required to facilitate travel between Washington and Baltimore and the Eastern Shore. In addition, the Ocean City beach and the coastal bays are approaching their respective capacities to support recreational activities. Increasing the recreational potential of the beaches has resulted in a series of confrontation between Ocean City and the Corps of Engineers and a proposal in the Worcester County Comprehensive Plan to use the northern portion of Assateague Island for intense recreation. The applicant's proposed sewage treatment facilities would not aid in the resolution of these problems, but would promote development and increase the demands upon currently stressed facilities (highways, beaches, coastal bays, water supplies). If the proposed sewage treatment facilities are to be an integral part of a long-term development program for the basin, they should be developed in conjunction with:

- mass transportation system for the Eastern Shore,
- a comprehensive water supply program which coordinates with the sewerage plan,
- a stormwater and nonpoint source pollution control program, and
- a comprehensive recreational plan based upon a realistic carrying capacity of the basin.

Without these programs, the proposed project will exacerbate existing stresses upon the North Central Ocean Basin.

D. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES
OF THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The following discussion summarizes the adverse effects that the proposed project will have on the beneficial use of the environment by permanently committing land, construction materials, and biological, human, economic and aesthetic resources. These resource commitments have been separated into primary and secondary commitments.

Primary Resource Commitments

Land, approximately 48 additional acres, necessary at the treatment plant sites cannot be used for other purposes during the life of the treatment systems. Approximately 7.5 acres of bay bottom and saltmarsh will be irretrievably lost through filling for expansion of the Ocean City STP.

Funds to implement and design the project have been given a present worth value of \$63,397,600 by the applicant.

Labor will be irretrievably committed to the construction and operation of the collection, treatment, and disposal systems.

Materials, principally concrete and steel, will be committed to the construction of the project, but would have some salvage value at the end of the planning period.

Energy inputs will be irretrievably committed to the design, implementation, construction, and operation of the collection, treatment, and disposal systems.

Potential shellfishing areas in the Atlantic Ocean will be closed because of the discharge of sewage effluent. The existing closure area off Ocean City will have to be enlarged as discharges increase, and a new closure area will be designated around the new ocean outfall.

Secondary Resource Commitments

Secondary irreversible and irretrievable resource commitments are generated by new resort development in the North Central Ocean Basin.

Land will be committed to increased development in the study area. Approximately 11,000 acres of vacant land in

the proposed service area could be developed as a result of the project. Approximately 2,200 acres (22 percent) of this land is presently considered to be prime agricultural land.

Groundwater supplies for Ocean City could be subjected to saltwater intrusion as a result of increased withdrawals.

Energy will be irretrievable committed to the production of construction materials and activities required for new growth in the area.

SECTION V

IDENTIFICATION AND EVALUATION OF ALTERNATIVES TO THE APPLICANT'S PROPOSED PROJECT

The following section of this environmental impact statement contains a discussion of alternative methods of achieving the goals described in Section I without producing some of the environmental consequences discussed in Section IV. The analysis of feasible alternatives is based upon information developed in the preceding sections of this statement. Alternatives are discussed in the following subsections:

Component Alternatives

- Collection System
- Treatment Processes
- Effluent Disinfection
- Effluent Disposal
- Sludge Management
- Treatment Capacity

System Alternatives

- Regionalization at Existing Facilities
- Regionalization at the Mainland STP
- Local Wastewater Management
- Nonstructural Controls
- No Action

V. IDENTIFICATION AND EVALUATION OF ALTERNATIVES TO THE APPLICANT'S PROPOSED PROJECT

Several alternatives to the proposed project are available to WCSC. Implementation of some of these alternatives would permit the applicant to attain the goals and objectives described in Section I without incurring many of the adverse environmental consequences discussed in Section IV. These alternatives may be classified as either component or system alternatives.

A. COMPONENT ALTERNATIVES

Component alternatives include unit processes and/or equipment available to the applicant for the treatment and disposal of wastewater and sludge. Included in this category are alternative collection systems, and methods of sewage treatment, effluent disinfection and disposal, and sludge management. Discussion of treatment plant capacity is also included as a component alternative to the applicant's proposed project.

1. Collection System

With the exception of the Isle of Wight transmission and collection system which would be constructed in 1985, GMB (1977) proposed construction of all major interceptors and pumping stations by 1980. GMB based this proposal upon the premise that existing population densities require that the system be installed by 1980.

After reviewing the available data, EPA has concluded that:

- the proposed regional collection system would serve only three designated "failing septic tank areas": West Ocean City, Snug Harbor, and the vicinity of Berlin;
- by serving Snug Harbor, the interceptor would promote development of the Route 611 corridor;
- if the Ocean Pines STP remains functional and continues to meet its NPDES effluent limitations, no major population centers or failing septic tank areas would be served by the Route 589-Route 90 interceptor;
- existing population forecasts for the North Central Ocean Basin do not account for recent concerns expressed by President Carter about fuel conservation, increasing fuel prices, and transportation difficulties on the Eastern Shore.

EPA recognizes that the proposed collection system is a significant component of Worcester County's future land use plan. However, provision of the proposed collection facilities at one time would reduce the County's ability to control growth within the service area by removing the major, physical growth-regulating mechanism.

EPA (1977) proposed that interceptor routes shall be planned to serve "existing developments and those areas where development is well underway." An interceptor may be provided during an initial stage to eliminate an existing point source discharge and to accommodate flows from existing developments or areas where development is occurring. Unless necessary to meet these objectives, interceptors shall not be extended into undeveloped areas. EPA questions the necessity of immediately eliminating the Ocean Pines discharge, especially when the required interceptor would promote development in the Turville and Jenkins Neck area and on the Isle of Wight.

Therefore, EPA has concluded that phasing major sections of the proposed collection system would aid the County in regulating growth and development in the service area. The phasing alternative would include:

- construction of the Route 50 interceptor from Berlin to West Ocean City and connection with a regional facility. This would permit two failing septic tank areas and several significant point source discharges to be eliminated. In addition, the Route 50 corridor would be available for further development. In order not to remove the option of transporting sewage from the Jenkins Neck area to a regional treatment facility in the future, interceptor capacities would be similar to those proposed by GMB (1977)
- construction of the Route 611 interceptor to Route 376. If an alternative method of relieving sewerage problems at existing developments along the corridor becomes available, this interceptor could be deleted
- construction of the Route 589-Route 90 interceptor when the Ocean Pines STP discharge becomes a significant problem or other development in the Jenkins Neck area becomes sufficient to support the collection system

The major adverse impact of a phasing program would be the increase in capital costs resulting from inflation. However, these increases may be offset by more accurate prediction of capacity requirements in several of the

service areas as uncertainties about growth in the Basin are resolved. Resolution of these uncertainties would result in more efficient public investment and less chance of financing excessive conveyance capacities.

2. Treatment Processes

Any proposed wastewater treatment facility must provide a minimum of secondary treatment and produce an effluent which conforms with the water quality standards of the receiving stream in order to satisfy design requirements for an EPA construction grant. EPA (1973) determined the following minimum quality requirements for secondary effluent:

- BOD₅ - the arithmetic mean of effluent concentrations measured during 30 consecutive days shall not exceed 30 mg/l or 15 percent of the arithmetic mean of influent concentrations measured at approximately the same times during the same period (85 percent removal).
- Suspended solids - the arithmetic mean of concentrations measured during 30 consecutive days shall not exceed 30 mg/l or 15 percent of the arithmetic mean of influent concentrations measured at approximately the same times during the same period (85 percent removal).
- Fecal coliform bacteria - the geometric mean value for effluent samples collected during a period of 30 consecutive days shall not exceed 200/100 ml, and values for seven consecutive days shall not exceed 400/100 ml.
- pH - the pH of the effluent shall remain within the limits of 6.0 to 9.0.

Several different treatment processes are capable of satisfying these requirements (Table V-1). GMB has selected the pure-oxygen modification of the activated sludge process for use at the proposed North Central Ocean Basin treatment facilities. The pure-oxygen treatment process has associated costs and requirements similar to those of the conventional activated sludge process listed in Table V-1.

EPA recognizes that the proposed pure-oxygen treatment process is particularly advantageous for upgrading and expanding the Ocean City STP because the treatment units can be constructed and maintained in a relatively small area. However, available space is not a problem at the proposed mainland STP, and other less expensive, less energy-intensive secondary treatment processes remain viable alternatives.

V-4

Table V-1 . Comparison of Wastewater Treatment Alternatives for 8.9 mgd Sewage Treatment Plant.

	Capital (x10 ⁶ \$)	Operation (\$/1,000 gal)	Land Acres	Labor (man yrs./yr)	Energy (kwh/ day)	Maximum Sustainable Removal Efficiency (Percent)		
						BOD	SS	PO ₄
Primary Sedimentation	2.06	10.3	9.3	5.1	1,180	35	50	2-5
Aerated Stabili- zation Pond	0.69	25.1	89	0.95	4,250	70-90	70-90	<5
Trickling Filter	3.65	17.3	18.6	5.8	2,830	82-90	80-88	20-30
Activated Sludge (Conventional)	3.93	19.4	17.7	10.3	4,650	85-92	85-92	10-30
Activated Sludge with Coagulation and Filtration	5.77	32.6	27.0	14.3	9,750	94	99	95
Physical/Chemical	3.81	25.8	8.4	14.0	9,000	92	96	91
Extended Aeration		Not Practical for 8.9 mgd flows				85-90	85-90	8-15

NOTE: 1. Costs, energy, land, and labor requirements are from Battelle (1974). Costs are in 1973 Dollars.
 2. Disposal of effluent not included.
 3. Treatment and disposal of sludge not included.
 4. Maximum values used when ranges given.
 5. Plant size multiplier for Battelles 10 mgd profiles = 0.93.
 6. Adjustments for National Cost Index or local multipliers were not made.
 7. Scaling multiplier for 20.5 mgd plant = 1.65

The applicant's proposal would also provide an advantage of requiring expertise in a single treatment process rather than two different processes. However, this advantage may not be sufficient to compensate for the cost differential between the proposed treatment process and alternative processes.

Lagoons and/or trickling filters would provide the applicant with secondary treatment at less cost than the proposed treatment process (Table V-1). However, lagoons are normally used to treat flows less than 1 mgd, and a single facility to treat 8.9 mgd would require approximately 90 acres of land. The applicant's proposed site could not support such a facility, and purchasing sufficient land at another site would cost approximately \$180,000. An 8.9 mgd facility equipped with trickling filters would require approximately half of the land at the proposed site. The entire site could accommodate a 30 mgd facility, if necessary.

3. Effluent Disinfection

EPA (1973) determined that disinfection must be used in order to achieve the fecal coliform levels required by secondary treatment standards and to protect public health. Disinfection is the selective destruction of disease-producing organisms in sewage effluent before its disposal. Disease-producing organisms include bacteria, viruses, and amoebic cysts. Disinfection is normally accomplished through the use of chemicals (chlorine, bromine chloride, and ozone), or radiation (Metcalf and Eddy, 1972). Although disinfection is required before effluent can be discharged into the environment, the presence of a disinfectant in an effluent may produce undesirable environmental consequences. Therefore, sewage treatment facilities are being designed to provide maximum germicidal effect while discharging minimal quantities of disinfectant into receiving streams. These goals may be achieved by providing maximum initial mixing and adequate contact time; by producing a high quality effluent which has low concentrations of suspended solids, ammonia and dissolved organics; and by providing adequate safeguards against disinfectant overdose.

GMB has selected ozonation (ozone generated from pure oxygen) as the method of effluent disinfection for the North Central Ocean Basin plants. Table V-2 compares ozonation with alternative disinfection methods. The capital costs, operational costs, and energy requirements of an ozonation system are higher than for the alternative disinfection systems, except chlorination/dechlorination using activated carbon. Effective disinfection with ozone requires filtration of secondary effluent (i.e., tertiary

Table V-2 . Alternative Methods of Disinfecting Wastewater Treatment Plant Effluents (for a 10 mgd Plant) [Source: EPA (1975)].

<u>Process</u>	<u>Costs</u>		<u>Energy</u> (kwh/mg)	<u>Health Effects</u>	<u>Relative</u> <u>Aquatic</u> <u>Toxic Effects</u>
	<u>Capital (\$)</u>	<u>Operation</u> (¢/1,000 gal)			
Chlorine	190,000	1.42	90	Assume Chlorinated Organics	High
Chlorine/SO ₂	220,000	1.75	90	Assume Chlorinated Organics	Low
Chlorine/Activated Carbon	2,800,000	8.60	110	Assume Minimal	Low
Ozone from Air ¹	1,070,000	4.02	800	Unknown	Low
Ozone from Oxygen ¹	700,000	3.49	400	Unknown	Low
Ultraviolet ¹	360,000	2.70	350	Assume Minimal	Assume Low
Bromine Chloride	130,000	3.04	90	Halogenated Organics	Intermediate

¹ Needs Tertiary Treatment (filtration) before Disinfection.

treatment) (EPA, 1975). GMB did not include effluent filtration in the proposed treatment process. Therefore, it is questionable whether the proposed process will consistently meet the Maryland bacteriological standards, and whether it is cost-effective.

GMB's (1977) comparison of ozonation and chlorination costs (Table V-3) indicated that capital costs for ozonation are \$3,218,600 more than for chlorination, but operation and maintenance costs (present worth) are \$2,015,280 less. The total cost difference (\$1,203,320 neglecting salvage values) indicates that ozonation is not as cost-effective for disinfection as chlorination. In addition, the rapid dilution of effluent by the diffuser would provide rapid dilution for residual chlorine. Chlorinated effluent from the Ocean City STP has created no significant environmental problems in the immediate vicinity of the outfall.

4. Effluent Disposal

Ocean disposal of effluent from the proposed North Central Ocean Basin sewage treatment plants was the selected alternative because it is currently being practiced at Ocean City without significant adverse environmental results. In addition, ocean disposal is generally more reliable and less expensive than alternative disposal methods. Alternative methods reviewed by GMB (1977) included land application and well injection.

Land application of municipal sewage effluent is a conceptually attractive method of disposal. Several beneficial effects may result from the application of secondary effluent to terrestrial habitats under proper management. Potentially problem-causing materials (BOD, pathogens, nutrients) are not discharged directly into surface waters. Inorganic nutrients and organic materials are removed from the wastewater and are diverted into terrestrial systems. Water is effectively diverted into the atmosphere or the groundwater. In addition, economic savings are possible by combining the fertilization and irrigation of crops into one process. Crop sales may defray the cost of disposal.

The three principal methods of land application are irrigation, infiltration-percolation, and overland flow (Table V-4).

Infiltration-percolation. This method is essentially a disposal technique and is generally considered as a direct discharge to groundwater. Preliminary treatment requirements normally exceed those of EPA's definition of secondary treatment. This requirement plus the lack of large areas with rapidly permeable

Table V-3. Capital and O&M Costs of Ozonation and Chlorination at the Proposed Ocean City and Mainland Sewage Treatment Plants.
[Source: GMB (1977) Alternative #2, Schemes 2 and 2b].

<u>Capital Costs</u>				
	<u>Ocean City</u>		<u>Mainland</u>	
	<u>Chlorine</u>	<u>Ozone</u>	<u>Chlorine</u>	<u>Ozone</u>
Phase I	\$ 7,362,000	\$ 8,471,900	\$4,858,900	\$5,591,500
Phase II	<u>5,985,400</u>	<u>6,887,700</u>	<u>3,142,300</u>	<u>3,616,100</u>
TOTAL	\$13,347,400	\$15,359,600	\$8,001,200	\$9,207,600
Total Capital Costs Ozonation			\$24,567,200	
Total Capital Costs Chlorination			<u>21,348,600</u>	
Difference			\$ 3,218,600	

<u>Annual Operation and Maintenance</u>				
	<u>Ocean City</u>		<u>Mainland</u>	
	<u>Chlorine</u>	<u>Ozone</u>	<u>Chlorine</u>	<u>Ozone</u>
Phase I	\$418,900	\$355,700	\$302,700	\$260,400
Phase II	<u>343,900</u>	<u>292,000</u>	<u>169,800</u>	<u>146,100</u>
TOTAL	\$762,800	\$647,700	\$472,500	\$406,500
			<u>Annual</u>	
Total O&M Costs Ozonation			\$1,054,200	
Total O&M Costs Chlorination			<u>1,235,300</u>	
Difference			\$ (181,100)	
Present Worth Difference			\$2,015,280	

Table V-4. Comparative Characteristics of Irrigation, Infiltration-Percolation, and Overland Flow Systems for Municipal Wastewater. [Source: Pound et al., (1975)].

Factor	Spray Irrigation		Infiltration-Percolation	Overland Flow
	Low-Rate	High-Rate		
Liquid loading rate, in./wk.	0.5 to 1.5	1.5 to 4.0	4 to 120	2 to 9
Annual application, ft/yr	2 to 4	4 to 18	18 to 500	8 to 40
Land required for 1 mgd flow-rate, acres ^a	280 to 560	62 to 280	2 to 62	28 to 140
Application techniques	Spray or Surface		Usually Surface	Usually Spray
Vegetation required	Yes	Yes	No	Yes
Crop production	Excellent	Good/Fair	Poor/None	Fair/Poor
Soils	Moderately permeable soils with good productivity when irrigated		Rapidly permeable soils, such as sands, loamy sands, and sandy loams	Slowly permeable soils, such as clay loams and clays
Climatic constraints	Storage often needed		Reduce loadings in freezing weather	Storage often needed
Wastewater lost to:	Evaporation and percolation		Percolation	Surface runoff and evaporation with some percolation

V-10

Table V-4. Continued.

<u>Factor</u>	<u>Spray Irrigation</u>		<u>Infiltration- Percolation</u>	<u>Overland Flow</u>
	<u>Low-Rate</u>	<u>High-Rate</u>		
Expected treatment performance				
BOD and SS removal	98%		85 to 99%	92%
Nitrogen removal	85% ^a		0 to 50%	70 to 90%
Phosphorus removal	80 to 99%		60 to 95%	40 to 80%

^a Dependent on crop uptake.

soils in the North Central Ocean Basin would appear to preclude this method as a feasible disposal technique.

Overland flow. This is essentially a treatment technique and not a disposal technique. It requires an ultimate point of discharge for the runoff from the site. An additional site requirement for this method is a slope of 2-4 percent. Slopes of this magnitude are not generally available over extensive (hundred acre) areas within the Basin. These two requirements would appear to eliminate overland flow as a feasible alternative for the study area.

Spray irrigation. This method is considered to be both a treatment and a disposal technique. No single requirement of the State of Maryland (Table V-5) precludes the use of this technique within the North Central Ocean Basin. Guidelines for evaluating the feasibility of land application of sewage effluent were presented in a draft document prepared jointly by WRA and EHA (1976) entitled A Procedures Manual and Guideline for Evaluation and Selection of Discharge Alternatives. However several factors require evaluation before the feasibility of spray irrigation can be determined for the study area. The principal factors are local land uses, land requirements, soil types, groundwater levels, costs of land acquisition, storage during non-operating periods, capital investment, and operation and maintenance costs. Possible implementation problems must also be recognized.

- Land use. Four future land use categories are projected for the mainland area: Rural, Agricultural, Conservation, and Suburban. Of these four categories, Suburban and Conservation areas can be eliminated as unavailable for land disposal sites. The total combined acreage of future rural and agricultural land is 35,476 acres or 57.1 percent of the study area. Several large areas of land along the western boundary of the Basin have land uses potentially compatible with land application of effluent.
- Land requirements. The amount of land required for a successful spray irrigation operation can be estimated from the application rate (in/wk), effluent volume (mgd), and the number of non-operating weeks per year (Pound et al., 1975). GMB (1976) estimated that spray irrigation from an 8.9 mgd Mainland STP would require 4,000 acres

TABLE V-5. State of Maryland Guidelines for Evaluating the Feasibility of Using Spray Irrigation for Sewage Effluent Disposal. [Source: WRA (1976)]

- Soils
- Sandy loams to clay loams are suitable
 - Well drained with adequate infiltration capacity for 1/2 inch - 2 inch and 1/16 - 1/4 application rate
 - Soil depth of 4-5 feet is preferred

Vegetative Cover

- Grasses or crops
- Woodlands where discharge is primary purpose

Groundwater

- Minimum depth of 4 feet to groundwater
- However, minimum depth of 2 feet may be permitted in areas east of the Fall Line
- Reduced application rates and/or underdrains may be considered when groundwater depth minimum

- Slopes - up to 15 percent

Additional conditions for discharge permits

- Effluent must satisfy EPA's definition of secondary treatment (BOD₅ and suspended solids concentrations of 30 mg/l)
- Application rate is based on infiltration capacity of soil but shall not exceed 104 inches/year or hourly or weekly rate or half of the infiltration capacity of soil
- No runoff or ponding at site
- Disinfection level - case by case
- Crops for human consumption generally not utilizable
- Dairy pasturing lands are not utilizable
- Minimum 30-day on-site storage capacity
- Effluent and groundwater quality must be monitored
- Operation normally carried out only one day/week on a given section
- Reserve irrigation area should be considered but shall not exceed 25 percent of the design area

of land. This estimate was based on an assumed application rate of one inch/week and 22 non-operating weeks per year.

- Soils and Groundwater. Only soil types A1 and B1 have groundwater tables lower than 2 feet from the soil surface which is required for spray irrigation operations. Approximately 12,000 acres of these soil types occur within the study area but not in continuous 4,000 acre tracts. However, water table levels drop substantially during the growing season in most soils of the study area, and this might permit other soil types to comply with state standards during that period.

The State of Maryland also requires that the soil texture at a disposal site range from sandy loam to clay loam, in order that the effluent will percolate at a rate sufficient for treatment but not at a rate too rapid to prevent treatment and uptake by the vegetation. Because of this requirement, not all soils with the proper groundwater depths are suitable for spray irrigation operations. The combination of these two requirements, plus the requirement for approximately 4,000 acres of suitable land, makes an assessment of the feasibility of spray irrigation operation of this magnitude in the North Central Ocean Basin difficult. A more detailed investigation of individual disposal sites is necessary to determine the feasibility of land disposal. Once the feasibility of disposal at a specific site is established, then the total costs of a proposed operation can be estimated.

- Cost. The costs of a spray irrigation operation for the proposed 8.9 mgd Mainland plant can be estimated by making several assumptions:
 - 1) 8.9 mgd design flow
 - 2) 25 non-operating weeks per year
 - a) storage requirements for 4 mgd during non-operating periods
 - b) unlined storage facility
 - 3) force main transmission system at each pump station
 - 4) 3 miles of transmission lines

- 5) 1 inch/week application rate
- 6) no land costs
- 7) spray irrigation
 - a) solid set (buried) for crops
 - b) no underdrains
- 8) no crop revenues

Using these assumptions, the estimated cost of the land disposal system only, is \$9.3 million (1973 dollars).

Before land disposal can be considered as a feasible alternative, a suitable site must be identified. The process of identifying suitable sites in the study area will probably require an increase in the scope of the facilities plan, because more detailed analysis of specific sites must be performed by WRA in cooperation with WCSC.

If land disposal within the study area is ultimately selected as the disposal method and a suitable site is found, then discharge and construction permits are required from WRA and DHMH.

The local owner of the proposed land disposal sites may not be willing to sell the land (if purchase of the site is preferred) or to cooperate in the implementation of the land disposal operations on his land. In addition, local public reaction may not be conducive to a land disposal operation within the study area.

Wetland Disposal. The application of sewage effluent to wetlands as a form of treatment is an area of active research in various parts of the country. Theoretically, the organic and inorganic constituents of the effluent can be cycled into biological and chemical components of the system. Nutrients are assimilated by growing plants. BOD concentrations are reduced, and suspended solids deposited in the quiescent waters. The State of Maryland has concluded that this technique is not a viable alternative in the North Central Ocean Basin because it would constitute a direct discharge to the coastal bays.

Ocean disposal alternatives analyzed by GMB (1977) included an outfall from northern Fenwick Island and two outfall corridors across Assateague Island. The selected plan included two treatment facilities with the outfall from the Mainland STP crossing the northern portion of Assateague Island (Airport outfall).

Environmental impacts of the proposed outfall crossing West Ocean City Airport are discussed in Section IV. The impacts of an outfall located along the Assateague Island Bridge would be substantially greater than the Airport outfall because of the significantly larger area of regularly flooded salt marsh, bay bottom, and barrier island that would be traversed. Total capital costs would also be more than \$6,900,000 (GMB, 1977).

EPA reviewed the alternative of crossing the southern portion of Fenwick Island with an outfall rather than installing the proposed outfall across Assateague Island. The alternative outfall would extend from the Mainland STP north to Route 50. At Route 50 the outfall would extend east beneath Isle of Wight Bay near the Route 50 Bridge, across the southern tip of Fenwick Island (Caroline Street), and into the Atlantic Ocean. The outfall would extend for a sufficient distance into the ocean to prevent contamination of the beaches and the coastal bays by the effluent. This distance would be determined by the dispersion studies to be prepared by CBI. In Ocean City the outfall corridor would include approximately 1,400 feet of street (Figure V-1) and 350 feet of beach.

If sufficient land is not available in Ocean City to expand the treatment plant beyond a capacity of 12 mgd, sewage from the southern portion of Fenwick Island will be conveyed to the mainland for treatment (Alternative 4, GMB, 1977). Environmental damage of the interceptor and the outfall could be minimized by installing them during the same operation and in a single corridor in the vicinity of the Route 50 Bridge. Installation of these pipes would have to be coordinated with the Coast Guard, Corps of Engineers, and State Highway Administration. However, this coordination would be required by the single crossing included in GMB's (1977) Alternative 4. The addition of the outfall to the proposed crossing would not significantly affect the coordination process and would eliminate the requirement for coordination with the National Park Service to cross Assateague Island.

The alternative, South Fenwick outfall would cost at least \$1,656,000 more than the proposed Assateague Island outfall. In addition, the Mayor and City Council have expressed opposition to an outfall offshore from the intensively used beaches in this area.



A



B

C



FIGURE V-1. THE CORRIDOR OF THE
OUTFALL IN OCEAN CITY FROM
THE ROUTE 50 BRIDGE EAST TO-
WARD THE ATLANTIC OCEAN.

EPA has preliminarily concluded that the Assateague Island outfall is cost-effective and will not impose long-term environmental damage to the National Park.

5. Sludge Management

The applicant has selected land application of liquid sludge as the principal component of a sludge management program for the North Central Ocean Basin. The proposed program consists of incinerating primary sludge at the Ocean City STP and land applying the secondary sludge. All sludge from the Mainland STP would be applied to the land. Alternatives available to the applicant include incineration, land filling, and composting.

Incineration alone is a volume reduction technique rather than ultimate disposal (EPA, 1976). After incineration, ash, either dry or in scrubber water, must be disposed of on land. Ash disposal must be designed to protect groundwater, to prevent dust, and to ensure no erosion to surface waters. Emissions from a sludge incinerator must not result in violation of ambient air quality standards and must satisfy EPA air pollution standards of performance. WRA (1976) proposed that incineration can be an economical and environmentally acceptable sludge management technique. WRA (1976) noted that the advantages of the technique include:

- production of a chemically and biologically inert and sterile ash, and
- significant reduction in the volume of material to be disposed of.

The primary disadvantages of incineration include:

- high capital and operating costs,
- production of air pollutants (particulate and gaseous) and odors,
- requirement for supplemental fuel, and
- difficulty in sustaining proper operation.

Incineration has been used successfully at the Ocean City STP without incurring the last three primary disadvantages listed by WRA.

GMB (1977) considered use of incineration as a major component of a sludge management program only for the alternative of regionalization at Ocean City (Alternative #1). Cost estimates provided by GMB (1977) indicated that incineration was approximately twice as expensive as land application. The principal environmental concern about incineration is

the emission of air pollutants in a densely developed area. For example, Playland, a large amusement park, is immediately adjacent to the existing incinerator. The largest volume of sludge and the greatest emission loads would correspond to the most intense use of the area.

Land application of liquid sludge was selected as the sludge disposal technique for the North Central Ocean Basin sewage treatment plants (GMB, 1977). With rising costs of chemical fertilizers and growing public concern about resource recovery and waste prevention, use of sewage sludge as a fertilizer and soil conditioner is becoming more desirable.

Liquid sludge is applied as a slurry, generally containing less than 8 percent solids. The sludge contains all of the essential plant nutrients (EPA, 1974). Approximately 1-7 percent of digested sludge is nitrogen (N) (Walker, 1975), and based on samples from two plants, approximately 3 percent is phosphorus (P) and 1 percent is potassium (K) (Kirkham, 1974). Therefore, the ratio of potassium to nitrogen and phosphorus in sludge is low in relation to crop requirements. Consequently, the use of digested sludge at a rate sufficient to supply the nitrogen requirements of a crop will usually not supply enough potassium (EPA, 1974).

Nitrogen is usually the first factor which limits the sludge application rate due to the potential danger of groundwater pollution by nitrate leaching. To avoid this, DHMH, which grants permits for sludge disposal, requires that the amount of nitrogen applied not exceed crop uptake.

Although pathogens (bacteria, viruses, parasitic worms) will survive wastewater treatment processes, the presence of these organisms should not be a limiting factor (CWC, 1977) due to their rapid mortality in soil (Ohio Cooperative Extension Service, 1975). EPA (1974) stated "it has been reported that bacteria do not travel horizontally more than 100' through granular soils, that complete removal of *E. coli* was noted in about 16' of dune sands, and viruses were removed in a 2-foot bed of clean sand at moderate rates of application over a 7-month period." To provide further protection against pathogen exposure, application sites are usually isolated from the public.

For sludges having solids contents exceeding 2 percent, water is not usually a rate limiting factor (CWC, 1977). This, however, will also be taken into consideration by DHMH for each proposed application site before granting

an application permit.

Chemical elements in sludge that are potential hazards to plants or the food chain, or both, are: boron (B), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn) (CWC, 1977). Metal concentrations are highly variable in different sludges and therefore application rates limited by element levels can not be determined without chemical analyses of the sludge in question. Factors that affect the toxicity of metals to plants are (CWC, 1977):

- The quantity of toxic metals present in the soil.
- The toxic metals present. Different metals differ in their toxicity to specific plants and in specific soils.
- The pH of the amended soil. The toxic metal content safe at pH 7 can be lethal to most crops at pH 5.5. Land application may lead to a lowering of the soil pH due to nitrification of the added ammonia. Properly selected soil amendments can be used to alleviate this potential problem.
- The organic content of the amended soil. Organic matter chelates the toxic metals and reduces their ability to injure plants.
- The phosphate content of the amended soil. Phosphate reduces zinc availability to plants and decreases the stunting injury caused by excessive levels of toxic metals.
- The cation exchange capacity (C.E.C.). The C.E.C. of the soil is important in binding all cations, including the toxic metal cations. A soil with high C.E.C. is inherently safer for disposal of sludge than a soil with low C.E.C.

EPA (1976) proposed that chromium, lead, and mercury are relatively little hazard, if soil management is adequate (maintaining a pH of approximately 7.0, analyzing soil periodically, etc.). After a study of sludge amended soil at the Northeast Agronomy Research Center near Joliet, Illinois, Hinesly et al., (1976) stated "it appears that the potential for creating zinc and/or cadmium phytotoxic conditions in soils or increasing concentrations of elements in plant tissues to levels harmful to animals after sludge applications have been terminated has been seriously overstated by some researchers. It seems more likely that zinc and cadmium ions

were being rapidly incorporated into sparingly soluble compounds by precipitation reactions Thus, if phytotoxic conditions develop as a result of zinc and cadmium accumulation in soils from several years of continuous sludge applications, it will occur during the time sludge is being applied rather than after applications have been terminated."

According to Zenz et al. (1976), "the results a 4-year environmental monitoring program at a large digested sludge, land application project (in Fulton County, Illinois) have demonstrated the following:

- The water quality of surface discharges from fields receiving digested sludge application has averaged suspended solids, BOD, and fecal coliform levels of 60 mg/l, 6.0 mg/l, and 36 ctns/100 ml (geometric means), respectively.
- The water quality of a major stream which drains the digested sludge application project is unaffected by surface water discharges from the fields receiving digested sludge.
- Groundwater monitoring wells show no evidence of groundwater contamination due to digested sludge application to the soil's surface.
- After three years of sludge application through 1974, metal levels in corn grain grown on digested sludge-amended soils show no significant increase.
- Virus levels monitored from 1972-1974 at three surface water monitoring points indicate that surface water virus levels are not influenced by digested sludge application to the surrounding watershed.
- A study from 1971 through 1974 of the relative condition of fish living in several reservoirs which receive discharges from fields where digested sludge has been applied shows that these aquatic animals are not influenced by such applications."

The major advantage of land application of liquid sludge is the recycling of valuable nutrients and organic

substances with a minimum of nitrogen loss. Drying processes usually result in a significant loss of total nitrogen. Nitrogen loss may exceed 50 percent (CSC, 1977).

A major disadvantage of land application of liquid sludge is the requirement of relatively large areas for storage. Open retention vessels will allow dissemination of odors (Carroll et al., 1975). Excessive evaporation in these open vessels may also necessitate the addition of water before application to land. Some difficulty in resuspending sludges which have been retained due to long-term gravity separation of the solid and liquid phase of the sludge have been incurred (Carroll et al., 1975). Liquid sludge is also more difficult to handle than dried sludge. There are also fewer sources for disposal due to the presence of pathogens and the greater precautions necessary in transporting and distribution.

Land required for liquid sludge application is primarily dependent upon the nitrogen and heavy metal content of the sludge, heavy metal content of the soils, and the nitrogen requirements of applicable crops. Nitrogen is usually the first factor which limits application rates. According to DHMH (1976), the total amount of nitrogen applied must not exceed crop nitrogen requirements to insure against pollution of groundwaters. Heavy metal content of sludge and soil must also be considered when sludge is to be applied for long periods of time, usually more than 20 years, due to eventual heavy metal saturation.

A computer model was designed after Haith (1973) to determine the amount of land necessary to accommodate expected secondary sludge quantities produced in the North Central Ocean Basin in 1980 and at 5-year intervals thereafter until the year 2000. The application site was assumed to support 1 crop of corn and 1 crop of wheat per year which represents a total nitrogen requirement of 169.2 lbs. per acre (AES, 1977). Soybeans should not be used since they do not require external sources of nitrogen for high yields (AES, 1977). A 1:4 inorganic-organic nitrogen ratio was assumed with a 15 percent nitrification rate the first year and 3 percent every year thereafter. The maximum limit of total heavy metals was assumed to be 150 tons/acre and an organic nitrogen content of 3,000 lbs/acre.

Due to extreme population fluctuations in Ocean City caused by tourism, projected annual maximum, secondary, sludge production at the Ocean City STP must be based at least upon average monthly wastewater flows. Monthly averages were calculated using 1975 flow data (GMB, 1977). Averages were

then converted to relative percentages and used to calculate maximum yearly total solids and nitrogen production assuming a maximum of 40,000 gallons of sludge (6 percent solids) produced per 12.0 mgd (GMB, 1977). Monthly average sludge production at the proposed mainland plant was calculated based upon seasonal population in Berlin, available as summer and year-round residents (GMB, 1977). A 2.5 percent nitrogen content (dry weight basis) was assumed. This is the minimum concentration expected; the actual value may be much higher as Sommen (no date, in CSC, 1977) found the mean value at 38 aerobic treatment plants to be 4.9 percent. Acreages needed to apply secondary liquid sludge derived from both treatment plants are:

<u>Year</u>	<u>Acres</u>
1980	377
1985	588
1990	789
1995	1,013
2000	1,237

Annual costs for storage and land application of secondary liquid sludge expected to be produced in the year 2000 are presented in Table V-6. Storage requirements were based upon May-September secondary sludge production rates because wastewater flows were greater in this growing season in 1975 than during October-April.

Composting is a sludge stabilization process which is accomplished through the oxidation of organic matter by thermophilic organisms. Techniques most often used to compost are windrow and static pile. Preparation for composting is similar in both methods. Dewatered sludge (20 percent solids) is mixed with a bulking agent (wood chips, bark chips, rice hulls, cubed solid waste, unscreened finish compost, etc.) to increase the porosity of the mixture thereby insuring aerobic conditions (to prevent odors) and high oxidation rates. The mixture is then shaped into windrows or piles as applicable. After preparation, the methods differ significantly.

Windrows must be turned daily to assure aerobic conditions and exposure of all sludge to lethal temperatures ($>55^{\circ}\text{C}$) produced near the center of the pile (CWC, 1977). Rotation continues for at least two weeks depending

Table V-6. Annual Costs for Storage and Land Application of Secondary Liquid Sludge Derived from both Treatment Plants in the Year 2000. [Source: Smith and Houck (1976); and Giffels/Black and Veatch (1977)].

<u>Item</u>	<u>Annual Costs (dollars)*</u>
Land for application (1,237 acres)	\$157,718
2 Tractors	5,200
2 Injectors	1,700
Hose	2,900
Garage	2,200
Site preparation	4,966
Fencing	7,449
Distribution system	52,820
Monitoring system	7,449
Annual labor	31,600
Injection system O&M	8,100
Storage lagoon:	
Land (6.9 acres to store 11.3×10^6 gallons)	880
Construction costs (\$425,000)	32,130
O&M - labor	1,805
- materials and supply	<u>40,000</u>
TOTAL	\$356,917

* Capital recovery factor used for:

Site development - (6.375 percent, 30 year)	= .0756
Equipment - (6.375 percent, 10 year)	= .1383
Land - (6.375 percent, infinite)	= .06375

upon weather conditions and composting efficiency. The windrows are then flattened for further drying (about two weeks) and eventually moved for a curing period of 30 days (Willson and Walker, 1973). This allows further drying and pathogen destruction in addition to separation of bulking agent and compost.

The static pile method utilizes a forced ventilation system which assures aerobic conditions and thorough distribution of lethal temperatures and therefore does not require turning. Sludge is piled to about an 8 foot height on top of a 1-foot thick base consisting of bulking material and a perforated pipe system (CSC, 1977). The pile is then covered with unscreened compost to help prevent the escape of odors and to provide protection from precipitation. Air which is drawn through the pile is then pumped into a finished compost pile for odor absorption. The air flow may be reversed after about the second week (Epstein et al, 1976). The sludge is essentially free of pathogens and is stabilized after approximately three weeks of ventilation (Epstein et al, 1976 in Colacicco, undated). Drying is completed via curing in windrows or thin layers. The purpose of curing is to ensure dissipation of phytotoxic gases, offensive odors, and destruction of any remaining pathogens.

A modification of the static, or aerated, pile is the aerated extended pile in which each day's sludge is added to the shoulder of the previous day's pile. Total operating area, amount of blanket material required for insulation and odor control, and amount of wood chips is decreased by about 50 percent (Epstein, undated).

The windrow method is restricted to the stabilization of various combinations of primary and waste activated sludges, whereas the static pile process can compost these in addition to raw sludge. Advantages of being able to compost raw sludge include the elimination of expensive digestors at the STP and a higher rate of stabilization during composting. The windrow method is unsuitable for composting raw sludge because of odor problems (Colacicco et al., undated).

The windrow technique is severely restricted by precipitation and temperature whereas the static pile method has operated successfully during temperatures as low as -7°C and rain totaling 7 inches per week. Temperatures produced in static piles are also higher than those created in windrows, and often exceed 70°C (Epstein, undated).

Compost produced by the windrow method generally contains detectable pathogens due to insufficient exposure of the entire mass to lethal temperatures (CWC, 1977). Epstein et al., (1976) found the static pile method eliminated total coliforms, fecal coliforms and salmonella bacteria more extensively than the windrow technique. They stated that windrow composting for two weeks followed by 30 days of curing resulted in appreciable survival of coliform and salmonella bacteria. Burge and Cramer's (1974) results were similar in that pathogen levels were detectable after windrow composting but not after static pile.

The windrow process typically requires 2 to 3 times more area than the static pile method. The latter also requires less equipment (CWC, 1977). Preliminary cost analyses also indicate that static pile costs are less than windrow (CWC, 1977).

Energy Research and Development Administration [ERDA] (1977) has proposed that the 30-day curing process could be replaced by radiation treatments thereby reducing time and cost of composting. A dry-compost irradiation facility has been designed for the Beltsville (Maryland) Agricultural Experiment Station to substantiate its operative and cost-effectiveness (ERDA, 1977).

Advantages of composting sewage sludge (Epstein, undated) are:

- The microbial decomposition reduces offensive odors and produces a stable decomposable organic material.
- Heat produced during decomposition can destroy many human pathogens.
- The product can be conveniently stored and easily and uniformly spread on land. In contrast, liquid sludge is difficult to handle and produces odors when stored.
- Composting raw sludge eliminates the need for expensive digestors or other means of sludge stabilization.
- An organic-resource material is produced which is an excellent soil conditioner containing low levels of plant micro- and macro-nutrients.

In addition, direct sale of compost to farmers could eliminate land purchasing costs and application expenses.

Most chicken farmers in the Basin possess equipment for spreading manure. This equipment is also capable of spreading compost (AES, 1977).

A major disadvantage of composting is the loss of total nitrogen to less than 3 percent on a dry weight basis (EPA, 1976). Typical compost contains an average of 1.5 percent nitrogen and 1 percent phosphorus (CWC, 1977). Heavy metal concentrations are unchanged by composting.

Although compost application to agricultural land may be permitted by DHMH, the sale of bagged compost in urban and suburban areas is currently prohibited. However, the issue is being reviewed by DHMH in conjunction with scientists at the Beltsville Agricultural Research Station with a decision anticipated within the year (Hooper, 1977).

Land required for compost application was determined in a manner similar to that for liquid sludge with the only exception being a 1.5 percent nitrogen concentration value for compost (CWC, 1977). Acreages needed to apply compost generated by the proposed treatment facilities are:

<u>Year</u>	<u>Acres</u>
1980	257
1985	388
1990	509
1995	644
2000	777

Capital costs for a composting facility having the capacity to process secondary sludge produced in the year 2000 are shown in Table V-7.

Annual costs for processing, storage, and land application are listed in Tables V-8 and V-9. Storage requirements were based upon May-September secondary sludge production rates since wastewater flows were greater in this growing season, in 1975, than during October-April.

Land application of liquid sludge versus compost. Although annual costs for storage and application of secondary liquid sludge expected to be produced in the year 2000 are \$26,344 less than annual costs for the processing, storage, and application of compost, the difference may be negated by transportation costs differences and replacement of digesters at both treatment plants with vacuum filters. Composting can process raw sludge but requires a 20 percent solids-sludge concentration. Vacuum filtration will also reduce the volume of sludge by 70 percent

Table V-7. Capital Costs for a Composting Facility Having the Capacity to Process Secondary Sludge Produced in the Year 2000.
[Source: Colacicco et al. (undated)].

<u>Item</u>	<u>Annual Costs (dollars)</u>
Site development:	
Asphalt pad (2.0 acres)	\$112,208
Roads, administration	17,407
Electrical work	26,780
Sewer	18,746
Pond, drainage	37,492
Engineering	<u>53,158</u>
TOTAL	\$265,791
Equipment:	
Office trailer	\$ 6,695
Storage	2,008
Front end loaders (2 pieces)	141,934
Screen	21,826
Tractor	6,293
Pickup	6,293
Blowers (33 pieces)	<u>3,348</u>
TOTAL	\$188,397
Land for composting facility (5 acres)	10,000
CAPITAL INVESTMENT	\$464,188

Table V-8. Annual Costs for a Composting Facility Having the Capacity to Process Secondary Sludge Produced in the Year 2000.
[Source: Colacicco et al. (undated)].

<u>Item</u>	<u>Annual Costs (dollars)</u>
Operating costs:	
Woodchips	\$ 46,865
Plastic pipe	16,336
Gasoline	3,080
Diesel	7,097
Electricity	2,008
Equipment maintenance	11,248
Equipment insurance	1,875
Pad, road maintenance	1,607
Water/sewer	670
Labor	103,772
Miscellaneous supplies	<u>5,892</u>
TOTAL	\$200,450
Capital Costs:	
Site development ^{1/}	20,093
Equipment ^{2/}	26,055
Land ^{3/}	<u>638</u>
TOTAL Annual Costs	\$247,236

^{1/} Capital recovery factor (6.375 percent, 30 year) = .3756
^{2/} Capital recovery factor (6.375 percent, 10 year) = .1343
^{3/} Capital recovery factor (6.375 percent, infinite) = .00873

Table V-9. Annual Costs for Storing and Land Applying Compost Expected to be Produced in the Year 2000. [Source: Colacicco et al. (undated), Smith and Houck (1976)].

<u>Item</u>	<u>Annual Costs (dollars)*</u>
Land for application (777 acres)	\$ 99,068
2 Manure spreaders	830
2 Tractors	3,319
Fencing costs	4,679
Monitoring system	4,679
Annual labor	19,848
Manure spreader maintenance	600
Storage:	
Land (0.69 acre)	88
Asphalt pad and roads	<u>2,914</u>
TOTAL	\$136,025

* Capital recovery factor used for:

Equipment - (6.375 percent, 10 year) = .1383
Land - (6.375 percent, infinite) = .06375

and, therefore, total transportation costs by approximately the same amount.

Liquid sludge application has an advantage over composting because it recycles approximately twice as much nitrogen. Composting, however, has the following advantages over liquid sludge application:

- High marketing potential. Since compost can be handled without the chance of pathogen exposure and odor problems, it can be marketed to farmers, nurseries, gardeners, tree farms, etc., and therefore eliminate the need for purchasing land for application and application expenses.
- Fewer implementation problems. This will be a result of the need for substantially less land (460 acres) and no pipeline distribution system.
- Transfer versatility. Eventual soil saturation with heavy metals will require movement of the application site. All composting equipment can easily be transferred to a new site. Transfer of the liquid sludge site, however, would be much more difficult and costly due to reconstruction of another large storage lagoon and removal and reestablishment of the pipeline distribution system.
- Less risk of groundwater pollution.

EPA has concluded that liquid sludge application and composting offer numerous advantages to the applicant. Several questions, including implementation, remain unresolved at this time. EPA proposes that liquid sludge application be implemented as a pilot project for the expansion and upgrading of the Ocean City STP. During the pilot program, the applicant will evaluate implementation problems, and the use of composting to manage the sludge from both the Ocean City and Mainland facilities.

6. Treatment Capacity

The applicant's proposed project includes expansion of the Ocean City STP from 12 to 20.5 mgd and construction of an 8.9 mgd facility on the mainland. The requirement for this capacity was proposed by GMB (1977) based upon increasing populations and per capita wastewater generation rates of 100 gallons per day except for the Sinepuxent Neck service area where 78 gpcd was assumed adequate. In the application for PL 92-500 funds, the applicant assumed that the proposed

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capacity of 29.4 mgd was sufficient to accommodate current and projected municipal and industrial wastes. EPA is concerned that the proposed 29.4 mgd would provide excessive treatment capacity, and that this capacity would permit rapid development of the study area resulting in undesirable environmental effects. EPA has reviewed available data to assess the treatment requirements for the North Central Ocean Basin.

In its review of the applicant's collection system, EPA proposed the alternative of not installing the major interceptors planned for the area north of U. S. Route 50. Adoption of that alternative would remove a total of 2.6 mgd from the required capacity (2.2 mgd from Ocean Pines and 0.4 mgd from Isle of Wight), and would reduce the required capacity in the year 2000 from 29.4 to 26.8 mgd (using GMB's 1977 flows).

In 1977 EPA published proposed cost effectiveness guidelines which questioned the use of 100 gpcd in wastewater flow projections, especially in areas where water consumption records are not available or do not support this flow. EPA (1977) proposed use of the following per capita wastewater generation rates:

- Non-SMSA cities and towns with projected total 10-year populations of 5,000 or less - 70 gpcd
- Non-SMSA cities and towns with projected total 10-year populations of 5,000 to 10,000 - 80 gpcd
- SMSA planning areas and other non-SMSA cities - 90 gpcd

Using these proposed generation rates EPA has determined that the treatment capacity requirement for the North Central Ocean Basin is 23.75 mgd (Table V-10). This capacity is 5.7 mgd less than the applicant's proposal and incorporates the elimination of the Route 90-589 interceptor.

Table V-10. Estimate of Wastewater Treatment Requirements of the North Central Ocean Basin Based upon EPA's (1977) Proposed Cost-Effectiveness Guidelines.

<u>Service Area</u>	<u>2000 Population</u>	<u>Per Capita Generation Rate</u>	<u>Wastewater Flow</u>
Ocean City	205,000	90 gpcd	18.45 mgd
West Ocean City	25,000	80 gpcd	2.00 mgd
Berlin	7,000	80 gpcd	1.46 mgd*
Route 50 Corridor	9,800	70 gpcd	0.69 mgd
Sinepuxent Neck	<u>16,220</u>	70 gpcd	<u>1.14 mgd</u>
TOTAL	263,020		23.74 mgd

In addition, the recent estimate of water supply requirements for Ocean City, prepared by Whitman Requardt & Associates (1977) does not correspond to the wastewater flows projected by GMB (1977). Whitman, Requardt proposed that 15 mgd would be a sufficient water supply for the year 2006. This maximum water supply is 5.5 mgd less than the capacity of the proposed sewage treatment facility. Incorporation of this reduced water supply with previous considerations, reduced per capita flows, would reduce the required capacity to 20.3 mgd for the entire Basin. Projections of treatment capacity requirements (GMB, 1977) do not incorporate the effects of reduced per capita water consumption.

EPA concurs with the applicant's proposal to phase development of treatment capacity for the North Central Ocean Basin. Phasing will permit both the applicant and EPA to evaluate population trends and capacity requirements preceding grant awards.

B. SYSTEM ALTERNATIVES

Based upon the environmental impacts identified in Section IV and the availability of several component alternatives, system alternatives are evaluated to provide the applicant with other means of avoiding the environmental consequences of the proposed project while attaining the goals included in Section I. Alternatives discussed in this section include the development of regional treatment facilities, nonstructural controls, and no action.

1. Regionalization at Existing Facilities

Two sewage treatment facilities with regionalization potential exist within the study area: Ocean City and Berlin. The regionalization potential of the Ocean Pines STP is limited to four mgd by its NPDES permit. Neither the Ocean City or Berlin facility was originally designed as a regional treatment facility, but the possibility of using these plants for regional wastewater treatment is reviewed briefly in this section. Either of the facilities could receive all wastewater generated in the North Central Ocean Basin by using an expanded collection system. Regionalization at either of these facilities would require expansion of that facility's treatment capacity to accommodate projected wastewater flows.

The Berlin STP was recently issued a new set of effluent criteria by WRA. These limitations will require AWT units at the plant if discharge to Trappe Creek is continued. A regional facility with direct discharge to Trappe Creek would not be compatible with Maryland's policy of no wasteload increases to the coastal bays and, therefore, is not a feasible alternative. Berlin's design engineer is evaluating spray irrigation as part of the facility planning process for the Town. Land application of effluent from a regional facility is not practical because sufficient suitable land is not available in the study area, and the capital and operational costs of land application are high in comparison to ocean disposal.

The Ocean City STP currently occupies enough land to accommodate an expansion to 12 mgd. However, the site is insufficient to expand to the 29.4 mgd projected regional flow. Filling of 7.5 acres of marsh and bay bottom could provide the necessary

land for a 20.5 mgd facility to serve Ocean City. However, in compliance with Administrators Decision Statement No. 4 (1973) and Executive Order 11990 (1977), EPA presently discourages the concept of any filling in Isle of Wight Bay. The property adjacent to the existing plant (11 acres) could be purchased for approximately \$3,000,000 and could possibly accommodate a 29.4 mgd regional plant at the one site. However, this cost is not eligible for PL 92-500 funding and would have to be borne by WCSC. Regionalization at Ocean City would:

- eliminate the need for an outfall crossing Sinepuxent Bay, marshland, and Assateague Island;
- eliminate the need for purchase and partial clearing of the proposed 40-acre mainland plant site on Sinepuxent Neck; and,
- reduce the chance of the region's wastewater effluent entering the coastal bays through Ocean City Inlet.

Total environmental damage associated with one regional plant at the existing Ocean City site will be less than or equal to that of the proposed project.

The applicant's regionalization alternative (GMB Alternative 1) is less costly than the proposed project (\$61,141,300 vs. \$63,397,600 total present worth, respectively, GMB, 1977, p. 7-175). The applicant's Alternative 1 includes \$336,000 and \$2,268,000 for land acquisition in Phases 2 and 3, respectively (Table V-10), and assumes that a separate plant (8.4 mgd) will be constructed at a site several miles north of the existing plant. EPA assumes that the capital and O&M costs for a single 29.4 mgd regional sewage treatment facility would be less than the sum of the equivalent costs for the applicant's proposed "regionalization" at two separate facilities with the same capacity in Ocean City. Acquisition of the property adjacent to the existing plant (\$3,000,000) would require an additional \$396,000 more than has been allotted for land acquisition in the applicant's Alternative 1. Regionalization at Ocean City appears to be cost effective even allowing for the inefficiencies of two discrete plant sites in Ocean City.

Table V-10. Capital and Annual O&M Costs of the Principal Components and Phases of a Regional Plant at Ocean City. [Source: GMB (1977) Alternative #1, Scheme 2b].

<u>Component</u>	<u>Capital Costs</u>		
	<u>Phase I (1980)</u> <u>(9 to 12 mgd)</u>	<u>Phase II (1980)</u> <u>(12 to 21 mgd)</u>	<u>Phase III (1990)^a</u> <u>(21 to 29.4 mgd)</u>
Wastewater Treatment Units	\$ 8,471,900	\$ 7,124,900	\$ 6,836,800
Land (Plant Site)	0	336,000	2,268,000
Sludge Treatment Units	1,092,100	918,500	881,300
Land (Sludge Disposal)	765,000	573,800	535,500
Ocean Outfall Extension	<u>0</u>	<u>1,800,000</u>	<u>7,200,000^b</u>
SUBTOTAL	\$10,329,000	\$10,753,200	\$17,721,600
Contingencies & Engineering (20%)	<u>2,065,800</u>	<u>2,150,600</u>	<u>3,544,300</u>
TOTAL	\$12,394,800	\$12,903,800	\$21,265,900

Annual Operation & Maintenance Costs

<u>Component</u>	<u>Phase I</u>	<u>Phase II</u>	<u>Phase III</u>
Wastewater Treatment	\$355,700	\$302,000	\$290,300
Sludge Treatment and Disposal	237,500	188,600	178,600
Effluent Disposal	<u>68,500^c</u>	<u>68,500^c</u>	<u>116,000^d</u>
TOTAL	\$661,700	\$559,100	\$584,900

a New site north of existing plant (i.e., two plants).

b New outfall.

c 1980 - 1990 Phases I & II.

d 1990 - 2000 Phases I, II, & III.

The applicant has proposed that because the purchase of Playland is not eligible for EPA funding, the cost of purchasing that site for a regional facility would significantly increase local user charges and substantially reduce the ability of citizens to connect to local collection systems. In addition, further regionalization at the site would require additional land purchases. These purchases would significantly increase the cost of future wastewater treatment facilities. EPA currently considers this latter concern a major drawback to the concept of regionalization at the existing facility.

Although the Ocean Pines STP was not considered as a regional facility, it could be incorporated, as a functional component, into a future regional wastewater treatment system for the North Central Ocean Basin. In order to incorporate the Ocean Pines facility into the public system, WCSC would have to purchase it from Maryland Marine Utilities, Inc. Preliminary discussions of this subject were conducted during the formulation of the facilities plan for the Basin but were abandoned before any agreement could be formulated.

The Ocean Pines STP has an NPDES permit to discharge 4.0 mgd of AWT effluent into the St. Martin River. Current design capacity is 1.0 mgd and summer wastewater flows are 0.4 mgd. The remaining unused capacity could be allocated to problem areas outside of Ocean Pines if WCSC controlled the facility. As a WCSC facility the Ocean Pines STP could be expanded to a maximum capacity of 4.0 mgd and serve as a subregional facility for the Jenkins-Turville Neck area.

A second suggestion presented to EPA would include providing secondary treatment at Ocean Pines and discharging the effluent into the Atlantic Ocean through the existing Ocean City outfall. As part of this proposal, effluent from the Ocean Pines facility would be transported across Isle of Wight Bay through an outfall attached to a proposed bridge to be constructed parallel to the existing Route 90 Bridge. This proposed outfall would eliminate a major discharge into the coastal bays and would provide more effective use of the Ocean City outfall, especially if the Ocean City STP cannot be expanded beyond 12 mgd. The principal problems with this proposal include acquisition of the treatment facility by WCSC, and coordination with the State Highway Administration. Any decision by WCSC should include a determination of the schedule for constructing the parallel bridge, which is currently mentioned only in a twenty-year needs survey of Worcester County. Implementation of this alternative without the bridge would require burying the outfall in Isle of Wight Bay.

2. Regionalization at the Mainland STP

The 40-acre Mainland STP site has sufficient land to accommodate a single, regional treatment facility. Construction and operation of such a facility would provide the cost benefits usually associated with regional treatment facilities. However, the alternative would include abandoning the 12 mgd secondary treatment facility at Ocean City. This would represent a significant loss of public investment unless the decision could be completed before the facility is upgraded and expanded. Regionalization at the Mainland site would preclude the necessity for future land purchases or wetland filling in Ocean City. In addition, land at the existing Ocean City STP could be used for other purposes when the treatment units are removed. At the estimated \$300,000 per acre (GMB, 1976), the land at the present site would be worth approximately \$2 million. Revenues derived from other uses of this land could be used to defray costs of demolition of the treatment facility.

Regionalization at the Mainland STP site would:

- eliminate the requirement for filling 7.5 acres of wetland west of the Ocean City STP,
- be compatible with an outfall crossing northern Assateague Island or the southern portion of Fenwick Island,
- eliminate potential traffic problems on the Route 90 bridge resulting from transport of sludge to composting or land application sites by large tank trucks, and
- eliminate the sludge incinerator from Ocean City.

GMB's (1977) Alternative 4 is probably the most cost-effective approach to regionalization at the Mainland STP. That approach includes maintaining the Ocean City STP at 12 mgd and locating the remaining treatment capacity on the mainland. This alternative provides more cost-effective utilization of existing facilities than the alternative of regionalizing all capacity on the mainland.

3. Non-Structural Alternatives

Non-structural alternatives provide a means for attaining and maintaining water quality standards without construction and/or expansion of the Mainland and Ocean City treatment plants. Non-structural measures are designed to minimize and/or eliminate the need for additional sewage treatment facilities. The following alternatives and their applicability to the study area have been considered in this section:

- Negative or No Growth Policy
- Educational Programs for Decreased Water Use and Wastewater Generation.
- Water and Sewer Rate Structure Alterations
- Legislation of Flow and Waste Reduction Devices
- Continued Use of Septic Tanks
- Industrial Reuse and Recycling
- No-Action Alternative

Negative or No Growth Policy

The pressure for new development in Worcester County is and will continue to be a function of the area's proximity to the coastal bays and Atlantic Ocean. Ocean City, which contains the only private land with ocean frontage has experienced the greatest development and will probably continue the same pattern of high density development. The County's bayshore areas are also in demand for development but to a lesser extent than Ocean City. Major developments such as Ocean Pines and Mystic Harbor illustrate the existing demand in the northern bayfront sections.

The growth policy established by the Worcester County Land Use Plan does not contain any type of "anti-growth" or "no-growth" policies. To be effective, a negative or no growth policy would have to be applied not only to the permanent population but also to the tourist population. Wastewater flows during the tourist season are nine times greater than the normal off-season period. Treatment

facilities must be designed for the peak tourist flows. Since Ocean City has already made a substantial investment in tourist facilities (hotels, amusements areas, etc.) and is reasonably close to the heavily populated northeast, a no growth policy would be difficult to implement.

Educational Programs for Decreased Water Use and Wastewater Generation

Educational programs to decrease water use are difficult to implement in areas with abundant water supplies. It is also difficult to provide an educational program which would reduce the water consumption of the tourists who spend only short periods of time in the area. In addition, local residents would probably resist public water-reduction programs as having adverse effect on the attractiveness of the region to tourists. Resistance would be lowered by a water crisis, but a significant water crisis has not occurred in the area to mobilize public opinion in favor of water conservation.

Water and Sewer Rate Structure Alterations

Increases in water and sewer rates as a means for reducing water consumption have not worked consistently in the past. A major reason why a rate structure increase would not be effective in reducing water use in the Ocean City area is the fact that this is a resort area, and the increased costs would be passed on to the tourist, with limited foreseeable effects on water consumption.

Legislation of Flow and Waste Reduction Devices

Legislation of flow-and waste-reduction devices might be a feasible non-structural alternative. Examples of legislation of flow and waste reduction devices include:

- Requiring the installation of water conserving devices in new construction,
- Prohibiting local sales of excessive water-using appliances,
- Controlling any new or expanding development of industry which uses excessive amounts of water,
- Providing tax incentives for buying water saving devices and/or tax disincentives for use or installations of excessive water using devices.

Per capita water consumption and sewage flows are projected to increase rapidly in the future as a more affluent society installs more water consuming appliances. A number of water conservation devices such as those listed below could easily be incorporated into existing building codes and result in 10 percent or greater reduction in flow consumption (Sharpe, 1976). Additional benefits would include reduced energy consumption and smaller demands upon the existing water supply.

Flow Control Devices

These devices limit the rate of flow from shower heads and faucets. These devices are usually orifice restrictors that fit into the supply lines for faucets or showers. Substantial savings can be achieved with flow-limiting devices in shower heads.

- Faucet Aerators - Faucet aerators are presently in wide use. Faucets with aerators provide an even flow of water and reduce splashing.
- Spray Taps - these taps are actually mini-showers designed for use in lavatory sinks and wash basins. Water is sprayed from the tap rather than flowing in a single stream as is the case with conventional faucets. The spray allows for faster washing and rinsing with less water.

Water-Saving Toilets

These devices are currently being manufactured and are required by local plumbing codes in some areas in the United States. The principal feature of this type of toilet is a smaller water reservoir than that of a conventional toilet. These toilets use only 3.5 gallons per flush as compared with 5 or 6 gallons for a standard toilet. This amounts to a savings of 30 percent in toilet water use. An improved toilet now in use in Britain is the two-cycle toilet. The difference between this toilet and the standard siphon toilet is that there are two separate flush cycles, one for urine and one for feces. The solid waste flush cycle uses 2.5 gallons per flush while the liquid waste cycle uses only 1.25 gallons per flush.

- Float assemblies of improved design are now available at most hardware stores. These are easily installed in most conventional water closets and cost approximately five dollars. Water savings using these devices are achieved by adjusting them to maintain a lower water level in the toilet reservoir and by improved leak detection features.

- Bricks and Plastic Bottles have been used to save water in flush toilets that are designed to use more water than is necessary for adequate flushing. The brick or plastic bottle is placed in the toilet reservoir, and the water it displaces (a little more than one quart) is saved every time the toilet is flushed.

Continued Use of Septic Tanks

Virtually all of the wastewater generated outside of sewerred areas within the planning area is disposed of through septic tank and tile drain systems. The poor suitability of soils in the area to septic systems, combined with the seasonally high water table and close proximity to the bays, has led to the failures of many septic tank systems with most failures concentrated in the areas shown in Figure I-4. In order for many of these areas to support moderate to high density development, central sewerage facilities must be provided. For areas outside of regional sewerage service, the septic systems must be improved or cluster systems must be designed to alleviate the pollution and public health problems caused by septic system failures.

GMB (1977) reviewed wastewater management alternatives for the communities of Bishopville, Showell, and Bishop. Alternatives evaluated for these communities included connection with the regional system, construction of a community system, use of cluster systems, and reliance on individual septic tanks. In all three communities, reliance on individual septic tanks was the most cost-effective and environmentally acceptable alternative. In preparing this analysis, GMB assumed that 50 percent of all septic tanks would be replaced during the planning period (1980-2000) and that each tank would be pumped out biannually. A major disadvantage of this alternative is that PL 92-500 funds are not available for installing individual septic tanks, and in some cases, the replacement of privies and other sewage transport systems may create a financial burden on poor families. Without financial assistance, these families may be unable to install a septic system. In all three communities the use of cluster systems with state and federal funding would reduce local capital costs to less than those for septic systems. However, the operation and maintenance costs for cluster systems are significantly higher than those for septic tanks. PL 92-500 funds would be available for capital costs required by WCSC to implement a septic tank maintenance program. EPA assumes that the principal component of these costs would be trucks

required to pump out septic tanks and transport the wastes to a sewage treatment plant. GMB (1977) noted that many septic tanks in Bishopville, Showell, and Bishop were located in soils suitable for operation of these systems, but that many of the systems had not been properly maintained. EPA proposes that a similar analysis for Snug Harbor would be appropriate, and if a septic tank maintenance program would relieve this area, it should be implemented.

4. No Action

This alternative assumes that EPA will not provide federal funding to support the applicant's proposed project. The "No Action" alternative implies that any new construction of wastewater treatment facilities will be supported entirely by financing from state and local sources. Under these conditions, two possible options exist for WCSC:

- Utilize available state and local revenue sources to finance construction of the proposed Mainland STP and expansion of the Ocean City STP. Loss of federal participation in financing the construction of the Mainland STP and the Ocean City STP expansion would necessitate reliance upon other sources of finance. The absence of the Federal government's percent share of the project costs will proportionately increase the financial burden upon the local communities (present and future residents). The potential ramifications of this alternative range from no change in the scope of the proposed action to possible major changes in treatment plant capacities, phasing of construction, treatment process changes or reduction of the geographic limits of the service area for the Mainland STP.

The delays involved in securing alternative funds would promote scattered, low density development dependent upon on-site disposal or upon package treatment plants. Since the Worcester County Comprehensive Plan recommends that suburban development occur in the eastern part of the County, package treatment plants serving this area would be required to dispose of effluent on the land because discharge into either Isle of Wight Bay or Sinepuxent Bay will not be permitted by WRA. This requirement would significantly increase the cost of these developments and severely restrict growth of the area.

- Adopt a "no build" option in which no public monies, either from state or local governments, would be utilized. Through this option, future wastewater demands would be satisfied partially through private construction of individual disposal systems (usually septic tanks and leaching fields), and package treatment plants. Any future growth and development in the area would depend upon a combination of individual on-site disposal systems and package treatment plants. Implications of the "No Build" option include increased per capita treatment costs, and excessively high environmental costs. Surface and groundwater quality would continue to degrade at an increasing rate. Public health conditions would be adversely affected as a result of the increased number of malfunctioning on-site disposal systems and anticipated failures of package treatment plants. Related biological impacts on surface waters would be severe, and the recreational and aesthetic qualities of the area would be diminished. In addition, severe socio-economic impacts could result from the closing of shellfishing areas which are currently on the margin of closure due to fecal coliform contamination caused partially by septic tank leachate.

SECTION VI

PRELIMINARY CONCLUSIONS

VI-1a

VI. PRELIMINARY CONCLUSIONS

EPA has developed the following preliminary conclusions based upon the information collected and analyzed during the preparation of the Draft EIS. The following list is a summary of the preliminary conclusions; a complete discussion of the rationale for each conclusion is provided in the EIS. These conclusions may be changed in response to comments provided to EPA during the public review of this EIS.

1. A significant discrepancy exists between projected water supply and projected sewage flows in Ocean City. GMB (1977) projects peak sewage flows in Ocean City to be 20.5 mgd by 2000. Whitman, Requardt & Associates (1977) estimated a peak water consumption of 13.7 mgd by 1998 for a population of 275,000. In addition, water consumption is calculated at an average rate of 50 gpcd. If the water consumption estimate is accurate, the design capacity of the proposed Ocean City treatment plant is excessive.
2. The applicant has requested a total sewage treatment capacity of 29.4 mgd. This capacity could be reduced by deleting the interceptor system north of U.S. Route 50 from the proposed project, by using EPA's (1977) per capita flows included in the proposed cost-effectiveness guidelines, and by coordinating the predicted sewage flows in Ocean City to the proposed water supply. Incorporation of these factors could reduce the total required capacity to 20.3 mgd.
3. Phasing construction of the regional collection system to immediately eliminate point source discharges and failing septic systems in West Ocean City, Berlin, and the Route 50 corridor would reduce the potential for growth inducement north of Route 50 and on Upper Sinepuxent Neck. Phasing could increase the total cost of the interceptor system through inflation, but the environmental benefits of reducing suburban sprawl and the potential for increasing the efficiency of the public investment may balance the increased costs.

4. The proposed use of ozone for effluent disinfection is neither cost-effective nor significantly more environmentally favorable than chlorination. The use of chlorine at the Ocean City STP has had no detectable adverse impact upon water quality or marine biota near the outfall. Mixing and dilution of residual chlorine discharged from the proposed facilities will eliminate any adverse impact from the disinfectant.
5. The discharge of effluent into the Atlantic Ocean is the most cost-effective and reliable alternative available to the applicant. The discharge of primary effluent from the Ocean City STP has produced no detectable impact upon marine biota or water quality near the outfall. The proposed outfall across Assateague Island will have minimal, short-term, adverse impact and no long-term impact on the island. An alternative outfall crossing southern Fenwick Island (Ocean City) would be more expensive but is a feasible alternative to the Assateague Island outfall.
6. EPA concurs with the applicant's decision to apply liquid sludge to the land. The first phase of that program should begin with the proposed expansion of the Ocean City STP from 9 to 12 mgd. EPA has requested that during the first phase, the applicant evaluate public acceptance of the program and the feasibility of composting the sludge from second-phase facilities.
7. Based upon information developed in this EIS, EPA believes that a modification of the applicant's alternative #4 is the most feasible available system alternative. The modification would include incorporation of the previously discussed component alternatives. Alternative #4 includes a 12 mgd STP at Ocean City and a 17.4 mgd facility on the Mainland. The Mainland facility's service area would include southern Ocean City and the regional collection system. Adoption of alternative #4 will be required because EPA will not permit the filling of 7.5 acres of wetland west of the Ocean City STP and other property adjacent to the facility is too expensive to purchase.

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R-1a

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APPENDIX A
SPECIES LISTS

A-1a

Table A-1. Mammals Most Likely to Occur Within the Planning Area Per Respective Habitat¹

	HABITAT				
	BAY	MARSH	SWAMP	FOREST	BARRIER DUMES
Sika deer <i>Cervus nippon</i>					x
White-tailed deer <i>Odocoileus virginianus</i>		x		x	x
House mouse <i>Mus musculus</i>				x	x
Norway rat <i>Rattus norvegicus</i>				x	x
White-footed mouse <i>Peromyscus leucopus</i>				x	x
Meadow vole <i>Microtus pennsylvanicus</i>		x			x
Meadow jumping mouse <i>Zapus hudsonius</i>		x	x		
Marsh rice rat <i>Oryzomys palustris</i>		x			
Least shrew <i>Cryptotis parva</i>		x			
Short-tailed shrew <i>Blarina brevicauda</i>		x		x	x
Eastern mole <i>Scapopus aquaticus</i>					x
Star-nose mole ² <i>Condylura cristata</i>			x	x	x
Big brown bat ² <i>Eptesicus fuscus</i>				x	
Little brown bat ² <i>Myotis lucifugus</i>				x	
Red bat 2 <i>Lasiurus borealis</i>				x	
Evening bat ² <i>Nycticeius humeralis</i>				x	
Hoary bat ² <i>Lasiurus cinereus</i>				x	
Silver-haired bat ² <i>Lasionycteris noctivagans</i>			x	x	
Eastern pipistrlle bat <i>Pipistrellus subflavus</i>				x	
Yellow bat ² <i>Lasiurus intermedius</i>				x	
Big-eared bat ² <i>Plecotus rafinesquii</i>				x	
Gray fox <i>Urocyon cinereoargenteus</i>		x		x	x

Table A-1 (Cont'd)

	HABITAT				BARRIER DUMES
	BAY	MARSH	SWAMP	FOREST	
Red fox ² <i>Vulpes fulva</i>		x		x	x
Virginia opossum <i>Didelphis virginiana</i>				x	x
Beaver <i>Castor canadensis</i>			x		
Raccoon <i>Procyon lotor</i>		x	x	x	x
Muskrat <i>Ondatra sibiricus</i>	x	x	x		
Mink <i>Mustela vison</i>	x	x			
River otter <i>Lutra canadensis</i>	x	x	x		
Nutria <i>Myocastor coypus</i>	x	x	x		
Eastern cottontail <i>Sylvilagus floridanus</i>				x	x
Marsh rabbit ² <i>Sylvilagus palustris</i>	x	x			
Gray squirrel ² <i>Sciurus carolinensis</i>				x	x

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the Interior.

2. The location of these mammals within the study area is possible although not absolutely certain. Their range extends into this part of the Atlantic but these mammals have not specifically been identified within Chincoteague Bay Region.

Table A-2. Amphibians Most Likely to Occur Within the Planning Area per Respective Habitat.

COMMON NAME	HABITAT			
	BAY	MARSH	FOREST	BARRIER DUNES
SALAMANDERS				
Two-toed amphiuma		x	x	
Marbled salamander		x	x	
Red-backed salamander			x	
Slimy salamander			x	
Tiger salamander		x	x	x
TOADS				
Eastern spadefoot toad			x	
Southern toad			x	
Fowlers toad			x	x
Eastern narrowmouth toad			x	
FROGS				
Pinewoods treefrog			x	
Spring peeper		x		
Green treefrog		x	x	
Gray treefrog		x	x	
Squirrel treefrog		x	x	
Northern cricket frog		x		
Southern cricket frog		x		
Brimley's chorus frog		x		
Southern leopard frog		x		
Carpenter frog		x		
Green frog	x	x		
Bull frog	x	x		

Sources: Howard, Needles, Tammen, and Bergendorf, 1975: False Cape State Park Transportation Access Study, Alexandria, Virginia, draft report, January 1975.

Conant, R., 1975: A Field Guide to Reptiles and Amphibians, Houghton Mifflin Co., Boston, Massachusetts.

Table A-3. Reptiles Most Likely to Occur Within the Planning Area per Respective Habitat.

COMMON NAME	HABITAT			
	BAY	MARSH	FOREST	BARRIER DUNES
TURTLES				
Common snapping turtle	x	x		
Musk turtle (stinkpot)	x			
Eastern mud turtle	x	x		
Spotted turtle	x	x		
Eastern box turtle			x	x
Diamondback terrapin	x	x		
Eastern painted turtle	x	x		
Yellow-bellied turtle	x	x		
Red-bellied turtle	x	x		
LIZARDS				
Eastern fence lizard			x	x
Six-lined racerunner			x	
Ground skink			x	x
Five-lined skink			x	x
Southeastern five-lined			x	x
Broadheaded skink			x	x
Slender glass lizard			x	x
SNAKES				
Brown water snake	x	x		
Red-bellied water snake	x	x		
Northern common water snake	x	x		
Red-bellied snake			x	
Common garter snake			x	x
Eastern ribbon snake		x		
Rough earth snake			x	
Smooth earth snake			x	
Eastern hognose snake				x
Southern ringneck snake			x	
Rainbow snake	x	x		x
Mud snake		x		
Black racer		x	x	x
Rough green snake		x		x
Black rat snake			x	
Eastern king snake		x	x	
Southern copperhead			x	
Eastern cottonmouth	x	x		
Coastal plain milksnake			x	x

Source: Howard, Needles, Tammen, and Bergendorf, 1975: False Cape State Park Transportation Access Study, Alexandria, Virginia, draft report, January 1975.

Conant, R., 1975: A Field Guide to Reptiles and Amphibians, Houghton Mifflin Co., Boston, Massachusetts.

Table A-4. Birds Most Likely to Occur With the Planning Area per Respective Habitat.¹

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
Common loon	x				x
Red-throated loon	x				x
Red-necked grebe	x	x			x
Horned grebe	x	x			x
Pied-billed grebe	x	x			x
Gannet					x
Double-crested cormorant	x				x
Great blue heron	x	x	x		
Green heron		x			
Little blue heron	x	x			
Cattle egret		x			
Snowy egret		x			
Louisiana heron		x			
Black-crowned night heron		x	x		
Yellow-crowned night heron		x			
Least bittern		x			
American bittern		x			
Glossy ibis	x	x			
Whistling swan	x				
Canada geese	x	x			
Brant	x	x			
Snow goose		x			
Snow (blue) goose		x			
Mallard	x	x			
Black duck	x	x			
Gadwall	x	x			
Pintail	x	x			
Green-winged teal	x	x			
Blue-winged teal	x	x			
European widgeon	x	x			
American widgeon	x	x			
Shoveler	x	x			
Wood duck		x	x		
Redhead	x				
Ring-necked duck	x	x			
Canvasback	x				
Greater scaup	x	x			x
Lesser scaup	x	x			x

Table A-4 (Cont'd)

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
Common goldeneye	x				x
Bufflehead	x	x			x
Oldsquaw	x				x
White-winged scoter	x				x
Surf scoter	x				x
Common scoter					x
Ruddy duck	x				
Hooded merganser	x	x			
Common merganser	x				
Red-breasted merganser	x				x
Turkey vulture	x	x		x	
Sharp-shinned hawk		x	x	x	
Cooper's hawk			x	x	
Red-tailed hawk		x	x		
Red-shouldered hawk		x	x		
Rough-legged hawk		x			
Southern bald eagle ²	x	x			
Marsh hawk	x	x			
Osprey	x	x			x
Arctic peregrine falcon ²	x	x			
Merlin			x	x	x
American kestrel		x		x	
Bobwhite				x	
King rail		x			
Clapper rail		x			
Virginia rail		x			
Sora		x			
Black rail		x			
Common gallinule		x			
American coot	x				
American oystercatcher	x			x	x
Semipalmated plover				x	
Wilson's plover				x	
Piping plover				x	
Killdeer		x		x	
Whimbrel		x		x	
American golden plover		x		x	
Upland plover					
Black-bellied plover		x		x	
Ruddy turnstone					x
Common snipe		x			
Spotted snadpiper		x		x	
Solitary sandpiper		x			
Willet		x		x	
Greater yellowlegs		x		x	
Lesser yellowlegs		x		x	
Knot		x		x	
Pectoral sandpiper		x		x	

Table A-4 (Cont'd)

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
White-rumped sandpiper		x		x	
Least sandpiper		x		x	
Dunlin		x		x	
Dowitcher, short-billed		x		x	
Dowitcher, long-billed		x		x	
Stilt sandpiper		x		x	
Semi-palmated sandpiper		x		x	
Western sandpiper		x		x	
Ruff		x			
Buff-breasted sandpiper		x			
Marbled godwit		x		x	
Sanderling				x	
American avocet		x			
Wilson's phalarope		x			x
Glaucous gull				x	x
Iceland gull				x	x
Great black-backed gull				x	x
Herring gull	x	x		x	x
Ring-billed gull	x	x		x	x
Laughing gull	x	x		x	x
Bonaparte's gull				x	x
Gull-billed tern		x		x	x
Forster's tern		x		x	x
Common tern	x			x	x
Roseate tern				x	x
Least tern	x			x	x
Royal tern	x			x	x
Sandwich tern				x	x
Caspian tern	x				
Black tern	x	x		x	x
Black skimmer	x	x		x	x
Dovekie					x
Mourning Dove			x	x	
Yellow-billed cuckoo			x	x	
Black-billed cuckoo			x	x	
Screech owl			x		
Great horned owl			x		
Chuck-will's widow			x		
Chimney swift		x			
Nighthawk	x	x	x	x	
Ruby-throated hummingbird	x	x	x	x	
Belted kingfisher	x	x			
Flicker			x		
Red-bellied woodpecker			x		
Red-headed woodpecker			x		
Yellow-bellied sapsucker			x		
Hairy woodpecker			x		
Downy woodpecker			x	x	
Eastern kingbird				x	
Western kingbird				x	

Table A-4 (Cont'd)

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
Great crested flycatcher			x	x	
Eastern phoebe		x	x		
Flycatcher (<i>Empidonax</i> spp.)			x		
Eastern wood peewee			x		
Horned lark		x		x	
Tree swallow	x	x	x	x	
Bank swallow	x	x	x	x	
Rough-winged swallow	x	x	x	x	
Barn swallow	x	x	x	x	
Purple martin	x	x	x	x	
Blue jay			x	x	
Common crow			x		x
Fish crow	x			x	
Carolina chickadee			x	x	
Tufted titmouse			x		
White-breasted nuthatch			x		
Red-breasted nuthatch			x		
Brown-headed nuthatch			x		
Brown creeper			x		
House wren			x	x	
Winter wren			x	x	
Carolina wren			x	x	
Long-billed marsh wren		x			
Short-billed marsh wren		x			
Mockingbird				x	
Catbird			x	x	
Brown thrasher			x	x	
American robin			x	x	
Wood thrush			x		
Hermit thrush			x		
Swainson's thrush			x		
Gray-cheeked thrush			x		
Veery			x		
Blue-gray gnatcatcher			x	x	
Golden-crowned kinglet			x	x	
Ruby-crowned kinglet			x	x	
Water pipit				x	
Cedar waxwing			x	x	
Loggerhead shrike			x	x	
White-eyed vireo			x		
Red-eyed vireo			x		
Black-and-white warbler			x		
Prothonotary warbler			x		
Orange-crowned warbler			x	x	
Northern parula			x	x	
Yellow warbler			x	x	
Magnolia warbler			x	x	

Table A-4 (Cont'd)

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
Cape May warbler			x	x	
Black-throated blue warbler			x		
Black-throated green warbler			x		
Blackpoll warbler			x	x	
Pine warbler			x		
Prairie warbler			x	x	
Palm warbler			x	x	
Ovenbird			x	x	
Northern waterthrush		x	x	x	
Kentucky warbler			x		
Yellowthroat		x	x		
Yellow-breasted chat		x	x	x	
Hooded warbler			x		
American redstart		x	x	x	
Bobolink		x			
Eastern meadowlark				x	
Redwing blackbird		x	x		
Rusty blackbird		x	x		
Common grackle		x			
Boat-tailed grackle		x		x	
Orchard oriole		x		x	
Baltimore oriole			x	x	
Scarlet tanager			x		
Summer tanager			x		
Cardinal			x	x	
Rose-breasted grosbeak			x	x	
Evening grosbeak			x		
Blue grosbeak				x	
Indigo bunting			x	x	
Purple finch			x		
Pine siskin			x		
American goldfinch				x	
Rufous-sided towhee			x	x	
Savannah sparrow				x	
Savannah (Ipswich) sparrow				x	
Grasshopper sparrow				x	
Sharp-tailed sparrow		x			
Seaside sparrow		x			
Vesper sparrow				x	
Slate-colored junco			x	x	
Tree sparrow			x	x	
Chipping sparrow			x		
Field sparrow				x	
White-crowned sparrow			x	x	

Table A-4 (Cont'd)

COMMON NAME	HABITAT				
	BAY	MARSH	FOREST	BEACH/ DUNES	OCEAN
White-throated sparrow			x	x	
Fox sparrow			x	x	
Swamp sparrow		x			
Song sparrow		x	x	x	
Snow bunting				x	

1. Sources: U. S. Fish and Wildlife Service, 1966a: "Birds of Chincoteague National Wildlife Refuge," Report No. RL-128-R2, U. S. Department of the Interior.

Ake, R., 1974: Ornithologist, Old Dominion University, Virginia Beach, Virginia, personal communication, October 1974.

2. Endangered species.

Table A-5. A Checklist of Marine Algae Collected from the Jetties at Ocean City Inlet During Summer, 1966. [Source: Wulff et al. (1968)].

Cyanophyta (Blue-green)

Entophysalis deusta
Entophysalis conferta
Lyngbya semiplena
Schizothrix calcicola
Calothrix crustacea
Calothrix confervicola

Rhodophyta (Red)

Bangia fusco-purpurea
Goniotrichum alsidii
Porphyra leucosticta
Porphyra umbilicalis
Acrochaetium trifilum
Acrochaetium virgatulum
Acrochaetium spp.
Nemalion multifidum
Gracilaria foliifera
Callithamnion baileyi
Ceramium fastigiatum
Ceramium strictum
Ceramium rubrum
Polysiphonia harveyi
Polysiphonia urceolata
Polysiphonia novae-angliae
Polysiphonia denudata

Phaeophyta (Brown)

Giffordia dushassaingiana
Petalonia fascia
Scytosiphon lomentaria
Fucus vesiculosus

Chlorophyta (Green)

Enteromorpha micrococca
Enteromorpha minima
Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha compressa
Enteromorpha prolifera
Ulva lactuca
Chaetomorpha aerea

Table A-6. Algae Most Likely to Occur with Assawoman, Isle of Wight,
and Sinepuxent Bays. [Source: Moul (1958)].

Agardhiella tenera
Bryopsis plumosa
Callithamnion sp.
Ceramium diaphanum
C. Rubrum
Chaetomorpha aurea
C. linum
Champia parvula
Ectocarpus confervoides
Enteromorpha sp.
E. intestinalis
Fucus vesiculosus spp. *spiralia*
F. vesiculosus
Gracilaria foliifera
Microcoleus sp.
M. chthonoplastes
Polysiphonia harveyi
P. nigrescens
P. variegata
Porophyra sp.
Scytosiphon lomentaria
Schisonema gravellii
Ulva lactuca
Vaucheria sp.

Table A-7.

Species List of Fish Collected in Seaside Waters of the Virginia Eastern Shore. [Source: Richards and Castagna (1970)].

Carcharias taurus
sand shark
Alopias vulpinus
thresher shark
Carcharhinus milberti
sandbar shark
Galeocerdo cuvieri
tiger shark
Mustelus canis
smooth dogfish
Negaprion brevirostris
lemon shark
Sphyrna zygaena
smooth hammerhead
Squalus acanthias
spiny dogfish
Squatina dumerili
Atlantic angel shark
Raja eglanteria
clearnose skate
Dasyatis americana
southern stingray
Dasyatis centroura
roughtail stingray
Dasyatis sayi
bluntnose stingray
Gymnura altavela
spiny butterfly ray
Gymnura micrura
smooth butterfly ray
Rhinoptera bonasus
cownose ray
Manta birostris
Atlantic manta
Elops saurus
ladyfish
Megalops atlantica
tarpon
Alosa aestivalis
blueback herring
Alosa mediocris
hickory shad
Alosa pseudoharengus
alewife
Alosa sapidissima
American shad
Brevoortia tyrannus
Atlantic menhaden

Clupea harengus
Atlantic herring
Anchoa hepsetus
striped anchovy
Anchoa mitchilli
bay anchovy
Synodus foetens
inshore lizardfish
Anguilla rostrata
American eel
Conger oceanicus
conger eel
Strongylura marina
Atlantic needlefish
Hyporhamphus sp.
halfbeak
Cryprinodon variegatus
sheepshead minnow
Fundulus heteroclitus
mummichog
Fundulus luciae
spotfin killifish
Fundulus majalis
striped killifish
Lucania parva
rainwater killifish
Pollachius virens
pollock
Urophycis chuss
squirrel hake
Urophycis regius
spotted hake
Apeltes quadracus
fourspine stickleback
Gasterosteus aculeatus
threespine stickleback
Hippocampus erectus
spotted seahorse
Syngnathus fuscus
northern pipefish
Holocentrus ascensionis
squirrel fish
Centropristes striatus
black seabass
Myxeroperca microlepis
cag
Morone americana
white perch

Table A-7 continued.

<i>Morone saxtilis</i>	<i>Myoxocephalus octodecemspinosus</i>
striped bass	longhorn sculpin
<i>Pristigenys alta</i>	<i>Astroscopus guttatus</i>
short bigeye	northern stargazer
<i>Pomatomus saltatrix</i>	<i>Rissola marginata</i>
bluefish	striped cusk-eel
<i>Rachycentron canadum</i>	<i>Peprilus triacanthus</i>
cobia	butterfish
<i>Trachinotus falcatus</i>	<i>Sphyræna borealis</i>
permit	northern sennet
<i>Orthopristis chrysopterus</i>	<i>Mugil cephalus</i>
pigfish	striped mullet
<i>Bairdiella chrysura</i>	<i>Mugil curema</i>
silver perch	white mullet
<i>Cynoscion regalis</i>	<i>Membras martinica</i>
weakfish	rough silverside
<i>Leiostomus xanthurus</i>	<i>Menidia beryllina</i>
spot	tidewater silverside
<i>Menticirrhus americanus</i>	<i>Menidia menidia</i>
southern kingfish	Atlantic silverside
<i>Menticirrhus saxatilis</i>	<i>Etropus crossotus</i>
northern kingfish	fringed flounder
<i>Micropogon undatus</i>	<i>Etropus microstomus</i>
Atlantic croaker	smallmouth flounder
<i>Pogonias cromis</i>	<i>Paralichthys dentatus</i>
black drum	summer flounder
<i>Sciaenops ocellata</i>	<i>Scophthalmus aquosus</i>
red drum	windowpane
<i>Mullus auratus</i>	<i>Pseudopleuronectes americanus</i>
red goatfish	winter flounder
<i>Stenotomus chrysops</i>	<i>Trinectes maculatus</i>
scup	hogchoker
<i>Tautoga onitis</i>	<i>Symphurus plagiusa</i>
tautog	black-cheek tonguefish
<i>Tautoglabrus adspersus</i>	<i>Echeneis naucrates</i>
cunner	sharksucker
<i>Gobiosoma boscii</i>	<i>Stephanolepis hispidus</i>
naked goby	planehead filefish
<i>Gobiosoma ginsburgi</i>	<i>Lagocephalus laevigatus</i>
seaboard goby	smooth puffer
<i>Microgobius thalassinus</i>	<i>Sphoeroides maculatus</i>
green goby	northern puffer
<i>Prionotus carolinus</i>	<i>Chilomycterus schoepfi</i>
northern searobin	striped burrfish
<i>Prionotus evolans</i>	<i>Opsanus tau</i>
striped searobin	oyster toadfish
	<i>Lophius americanus</i>
	goosefish

Table A-8. Species known to inhabit Isle of Wight-Assawoman or Sinepuxent-Chincoteague Bays or Their Inlets. [Source: Schwartz, 1964].

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Chincoteague Only</u>	<u>Isle of Wight- Assawoman Only</u>
Sand shark			
<i>Carcharias taurus</i>	X		
Thresher shark			
<i>Alopias vulpinus</i>			X
Sandbar shark			
<i>Carcharinus milberti</i>	X		
Smooth dogfish			
<i>Mustelus canis</i>	X		
Lemon shark			
<i>Negaprion brevirostris</i>			X
Smooth hammerhead			
<i>Sphyrna zygaena</i>			X
Spiny dogfish			
<i>Squalus acanthias</i>	X		
Dearnose skate			
<i>Raja eglanteria</i>	X		
Winter skate			
<i>Raja ocellata</i>		X	
Southern stingray			
<i>Dasyatis americana</i>	X		
Bluntnose stingray			
<i>Dasyatis sayi</i>			X
Smooth butterfly ray			
<i>Gymnura micrura</i>	X		
Cownose ray			
<i>Rhinoptera bonasus</i>	X		
Atlantic sturgeon			
<i>Acipensar (sturio) oxyrhynchus</i>		X	
Tarpon			
<i>Megalops atlantica</i>		X	
Hickory shad			
<i>Alosa mediocris</i>	X		
Alewife			
<i>Alosa pseudoharengus</i>	X		
American shad			
<i>Alosa sapidissima</i>	X		
Atlantic menhaden			
<i>Brevoortia tyrannus</i>	X		
Atlantic herring			
<i>Clupea harengus</i>	X		
Atlantic thread herring			
<i>Opisthonema oglinum</i>			X

Table A-8 continued.

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Cincoteague Only</u>	<u>Isle of Wight- Assawoman Only</u>
Carp			
<i>Cyprinus carpio</i>		X	
Striped anchovy			
<i>Anchoa h. hepsetus</i>	X		
Bay anchovy			
<i>Anchos m. mitchilli</i>	X		
Rainbow smelt			
<i>Osmerus mordax</i>		X?	
Redfin pickeral			
<i>Esox americanus</i>			X
Chain pickeral			
<i>Esox niger</i>	X		
Gafftopsail catfish			
<i>Bagre marinus</i>	X		
White catfish			
<i>Ictalurus catus</i>	X		
Brown bullhead			
<i>Ictalurus nebulosus</i>			X
Inshore lizardfish			
<i>Synodus foetens</i>	X		
American eel			
<i>Anquilla rostrata</i>	X		
Atlantic needlefish			
<i>Strongylura marina</i>	X		
Halfbeak			
<i>Hemiramphus unifasciatus</i>			X
Atlantic flying fish			
<i>Cypselurus heterurus</i>			X
Sheepshead minnow			
<i>Cyprinodon variegatus</i>	X		
Banded killifish			
<i>Fundulus diaphanus</i>			X
Mummichop			
<i>Fundulus heteroclitus macrolepidotus</i>	X		
Spotfin killifish			
<i>Fundulus luciae</i>	X?		
Striped killifish			
<i>Fundulus majalis</i>	X		
Rainwater killifish			
<i>Lucania parva</i>	X		
Mosquito fish			
<i>Gambusia affinis</i>	X		
Atlantic cod			
<i>Gadus morhua</i>		X	

Table A-8 continued.

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Chincoteague Only</u>	<u>Isle Of Wight- Assawoman Only</u>
Silver hake			
<i>Merluccius bilinearis</i>	X		
Atlantic tomcod			
<i>Microgadus tomcod</i>			X
Squirrel hake			
<i>Urophycis chuss</i>			X
Spotted hake			
<i>Urophycis regius</i>	X		
Fourspine stickleback			
<i>Apeltes quadracus</i>	X		
Threespine stickleback			
<i>Gasterosteus aculeatus</i>	X?		
Bluespotted cornet fish			
<i>Fistularia tabacaria</i>		X	
Spotted seahorse			
<i>Hippicampus erectus</i>	X		
Dusky pipefish			
<i>Syngnathus floridae</i>	X		
Northern pipefish			
<i>Syngnathus fuscus</i>	X		
Black seabass			
<i>Centropristes striatus</i>	X		
Snowy grouper			
<i>Epinephelus niveatus</i>			X
Gag			
<i>Myeteroperea microlepis</i>		X	
White perch			
<i>Morone americanas</i>	X		
Striped bass			
<i>Morone saxatilis</i>	X		
Pumpkinseed			
<i>Lepomis gibbosus</i>			X
Yellow perch			
<i>Perca flavescens</i>	X		
Bluefish			
<i>Pomatomus saltatrix</i>	X		
African pompano			
<i>Alectis crinitis</i>		X	
Blue runner			
<i>Caranx crysos</i>	X		
Crevalle jack			
<i>Caranx hippos</i>			X
Pilotfish			
<i>Naucrates ductor</i>			X
Lookdown			
<i>Selene vomer</i>			X

Table A-8 continued.

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Chincoteague Only</u>	<u>Isle of Wight- Assawoman Only</u>
Greater amberjack			
<i>Seriola dumerili</i>	X		
Atlantic moonfish			
<i>Vomer setipinnis</i>	X		
Spotfin mojarra			
<i>Eucinostomus argenteus</i>			X
Pigfish			
<i>Orthopristis chrysopterus</i>	X		
Silver perch			
<i>Dairdiella chrysura</i>	X		
Spotted seatrout			
<i>Cynoscion nebulosus</i>	X		
Weakfish			
<i>Cynoscion regalis</i>	X		
Banded drum			
<i>Larimus fasciatus</i>		X	
Spot			
<i>Leiostomus xanthurus</i>	X		
Southern kingfish			
<i>Menticirrhus americanus</i>		X	
Northern kingfish			
<i>Menticirrhus saxatilis</i>	X		
Atlantic croaker			
<i>Micropogon undulatus</i>	X		
Black drum			
<i>Pogonias cromis</i>	X		
Red drum			
<i>Sciaenops ocellata</i>	X		
Sheepshead			
<i>Archosargus probatocephalus</i>	X		
Pinfish			
<i>Lagodon rhomboides</i>	X		
Scup			
<i>Stenotomus chrysops</i>	X		
Atlantic spadefish			
<i>Chaetodipterus faber</i>		X	
Spotfin butterflyfish			
<i>Chaetodon ocellatus</i>	X		
Sergeant major			
<i>Abudefduf saxatilis</i>	X		
Tautog			
<i>Tautoga onitis</i>	X		
Cunner			
<i>Tautoglabrus adspersus</i>	X		

Table A-8 continued.

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Chincoteague Only</u>	<u>Isle of Wight- Assawoman Only</u>
Atlantic cutlassfish			
<i>Trichiurus lepturus</i>	X?		
Atlantic bonita			
<i>Sarda sarda</i>		X	
Spanish mackeral			
<i>Scomberomorus maculatus</i>		X	
Green goby			
<i>Microgobius thalassinus</i>			X
Naked goby			
<i>Gobiosoma bosci</i>	X		
Seaboard goby			
<i>Gobiosoma ginsburgi</i>	X		
Northern searobin			
<i>Prionotus carolinus</i>	X		
Striped searobin			
<i>Prionotus evolans</i>	X		
Northern stargazer			
<i>Astroscopus guttatus</i>	X		
Striped blenny			
<i>Chasmodes bosquianus</i>	X		
Feather blenny			
<i>Hypsoblennius hentzi</i>	X		
Striped cusk-eel			
<i>Rissola marginata</i>			X
Harvestfish			
<i>Peprilus alepidotus</i>	X		
Northern harvestfish			
<i>Peprilus paru</i>			X
Butterfish			
<i>Poronotus triacanthus</i>	X		
Great barracuda			
<i>Sphyraena barracuda</i>			X
Striped mullet			
<i>Mugil cephalus</i>	X		
White mullet			
<i>Mugil curema</i>	X		
Rough silverside			
<i>Membras martinica</i>			X
Tidewater silverside			
<i>Menidia b. beryllina</i>	X		
Atlantic silverside			
<i>Menidia m. menidia</i>	X		
Fringed flounder			
<i>Etropus crossotus</i>			X
Smallmouth flounder			
<i>Etropus microstomus</i>		X	

Table A-8 continued.

<u>Species</u>	<u>Both Bays</u>	<u>Sinepuxent- Chincoteague Only</u>	<u>Isle of Wight- Assawoman Only</u>
Summer Flounder			
<i>Paralichthys dentatus</i>	X		
Windowpane			
<i>Scophthalmus aquosus</i>	X		
Winter flounder			
<i>Pseudopleuronectes americanus</i>	X		
Hogchoaker			
<i>Trinectes m. maculatus</i>	X		
Cobia			
<i>Rachycentron canadum</i>		X	
Sharksucker			
<i>Echeneis naucrates</i>	X		
Skilletfish			
<i>Gobiesox strumosus</i>	X		
Orange filefish			
<i>Aluterus schoepfi</i>	X		
Gray triggerfish			
<i>Balistes capriscus</i>			X
Queen triggerfish			
<i>Balistes vetula</i>	X		
Bullseye puffer			
<i>Sphaeroides maculatus</i>	X		
Striped burrfish			
<i>Chilomyeterus schoepfi</i>	X		
Ocean sunfish			
<i>Mola mola</i>			X
Oyster toadfish			
<i>Opsanus lau</i>	X		
Goosefish			
<i>Lophius americanus</i>			X

Table A-9. Waterfowl Ground Surveys Overlooking the Atlantic Ocean at Assateague Island, 1973-1975.
[Source: Maryland DNR, 1973-1975].

<u>Year</u>	<u>W.W.¹ Scoter</u>	<u>Common Scoter</u>	<u>Surf Scoter</u>	<u>Surf/Com. Scoter</u>	<u>Unid.² Scoter</u>	<u>Old- Squaw</u>	<u>Total Seaducks</u>	<u>Mergansers</u>	<u>Buffle head</u>	<u>Unid. Diver</u>	<u>Black Duck</u>	<u>Unid. Dabber</u>	<u>Snow Goose</u>	<u>Brant</u>	<u>Can.³ Goose</u>
1973	12	2,420	3,013	2,780	-	97	8,322	-	-	-	-	-	-	1,472	-
1974	37	3,750	1,261	12,217	-	2	16,967	-	-	-	-	-	-	630	-
1975	183	3,092	3,340	2,707	1,149	0	10,471	109	1	49	6	7	-	2,019	-

¹ White Winged

² Unidentified

³ Canada

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Table A-10. Aerial Seaduck Surveys (1973-1975) in Assawoman, Isle of Wight and Sinepuxent Bays. [Source: Maryland DNR, 1973-1975].

	<u>Scoters</u>	<u>Old Squaw</u>	Goldeneye, Bufflehead, Scamp, <u>Merganser</u>	Other <u>Divers</u>	<u>Dabblers</u>	Brant, Snowgoose, Swan, Canada <u>goose</u>
Assawoman - Isle of Wight						
1973	9	0	150	1	400	90
1974	1	0	0	0	0	0
1975	0	0	0	0	0	30
Sinepuxent						
1973	10	0	151	0	0	1,212
1974	81	0	0	0	0	515
1975	8	0	3	15	6	581

APPENDIX B

SPECIFIC ANALYSIS
TECHNIQUES

B-1a

APPENDIX B

Nonpoint Source Pollution

Steady-state nonpoint source pollution loads to the coastal bays in the North Central Ocean Basin were estimated from the 1973 land use map prepared by MSDP and nonpoint source pollutant generation coefficients published by WRA (1976) and Uttormark, Chapin and Green (1974). The North Central Ocean Basin was divided into three smaller basins: Assawoman, Isle of Wight, and Sinepuxent-Newport. The areas of specific land uses within each of the basins were determined and the appropriate generation coefficients applied to each land use. Budgets were prepared for suspended sediment, nitrate and ammonia-nitrogen, total nitrogen, inorganic phosphorus, and total phosphorus. Nutrient budgets required the use of several assumptions for incorporation of the available data. The following land uses were placed in the following pollutant generation categories defined by Uttormark, Chapin and Green (1974):

Forest - average	Urban - high
Forest	Marinas
Forested Wetland	Quarries
	Strip Development
Urban - low	Agriculture - low
Airport	Wetlands
Highway	Pasture
Transportation	
Vacant (urban)	Agriculture - high
Institutional	Cropland
Schools	Feeding Operations
Urban - average	
Low Density Residential	
Medium Density Residential	
Mobile Home	
Commercial	

Table B-1. Nonpoint Source Pollution Generation Coefficients
(in Pounds per Acre per Year) Used in this Analysis.
Coefficients are modified from those presented
by Uttormark, Chapin, and Green (1974), Table 20.

	<u>Land Use</u>		
	<u>Urban</u>	<u>Forest</u>	<u>Agriculture</u>
NO ₃ - N + NH ₄ - N			
High	4.5	2.7	8.9
Low	0.9	0.4	0.9
Average	1.8	1.4	4.5
Total - N			
High	8.9	4.5	8.9
Low	2.2	0.9	1.8
Average	4.5	2.2	4.5
Inorganic P			
High	1.8	0.09	0.4
Low	0.4	0.009	0.04
Average	0.9	0.04	0.09
Total P			
High	4.5	0.7	0.9
Low	0.9	0.04	0.09
Average	1.3	0.2	0.3

TABLE B-2. Erosion Rates (in Pounds per Acre per Year) Used
in this Analysis. [Source: WRA (1976)].

<u>Land Use</u>	<u>Erosion Rate</u>
Idle Land	60
Forest	300
Grassland	1,520
Cropland, Treated	3,040
Urban	4,340
Cropland, Untreated	11,080
Surface Mined	22,140

Table B-3 Nonpoint Source Pollution Loads to Assawoman Bay from the North Central Ocean Basin.

Land Use	Area (acres)	Pollutant Load (lbs/yr)				
		Suspended Sediment	NO ₃ + NH ₃ Nitrogen	Total Nitrogen	Inorganic Phosphorus	Total Phosphorus
Low Density Residential	1,014	4,400,800	1,811	4,528	906	1,359
Medium Density Residential	189	820,200	337	843	169	253
Strip Development	477	2,070,200	2,130	4,260	852	2,130
Mobile Homes	192	833,200	343	858	172	257
Commercial	32	138,800	57	143	29	43
Vacant (Urban)	893	1,357,400	798	1,994	399	798
Cropland	1,133	12,553,600	10,119	10,119	506	1,012
Vegetated Wetland	1,616	0	1,443	2,886	72	144
Forested Wetland	128	0	183	286	6	23
Forest	1,389	416,800	1,985	3,100	62	248
TOTAL LOAD (lbs)		22,591,000	19,206	29,017	3,173	6,267
AVERAGE DAILY LOAD (lbs)		61,893	53	79	9	17

B-3

B-4

Table B-4 . Nonpoint Source Pollution Loads to Isle of Wight Bay from the North Central Ocean Basin.

<u>Land Use</u>	<u>Area (acres)</u>	<u>Pollutant Load (lbs/year)</u>				
		<u>Suspended Sediment</u>	<u>NO₃ + NH₃ Nitrogen</u>	<u>Total Nitrogen</u>	<u>Inorganic Phosphorus</u>	<u>Total Phosphorus</u>
Low Density Residential	4,086	17,734,000	7,298	18,244	3,649	5,473
Medium Density Residential	342	1,484,000	611	1,527	305	458
Mobile Homes	77	334,000	136	344	69	103
Schools	26	112,000	23	58	12	23
Transportation	45	196,000	40	100	20	40
Vacant (Urban)	278	422,000	248	621	124	248
Pasture	262	398,000	234	468	12	23
Cropland	15,190	168,306,000	135,652	135,652	6,783	13,565
Feeding Operations	353	1,528,000	3,144	3,144	157	314
Forested Wetland	528	0	754	1,179	24	94
Vegetated Wetland	995	0	889	1,777	45	89
Forest	12,147	3,644,000	17,356	27,119	542	2,169
Quarries	32	708,000	143	287	57	143
TOTAL LOAD (lbs)		194,866,000	166,528	190,520	11,799	22,742
AVERAGE DAILY LOAD (lbs)		533,880	456	522	32	62

Table B-5 . Nonpoint Source Pollution Loads to Sinepuxent and Newport Bays from the North Central Ocean Basin.

<u>Land Use</u>	<u>Area (acres)</u>	<u>Pollutant Load (lbs/year)</u>				
		<u>Suspended Sediment</u>	<u>NO₃ + NH₃ Nitrogen</u>	<u>Total Nitrogen</u>	<u>Inorganic Phosphorus</u>	<u>Total Phosphorus</u>
Low Density Residential	470	2,039,800	840	2,099	420	630
Medium Density Residential	595	2,582,400	1,063	2,657	531	797
Mobile Homes	77	334,200	138	344	69	103
Commercial	54	234,400	97	241	48	73
Institutional	42	63,800	37	94	19	37
Schools	96	416,600	86	215	43	86
Transportation	247	1,072,000	221	552	110	221
Marinas	38	165,000	170	340	68	170
Airport	131	199,200	117	293	59	117
Vacant (Urban)	694	1,054,800	620	1,550	310	620
Cropland	8,022	88,883,800	71,638	71,638	3,582	7,164
Feeding Operations	330	1,432,200	2,948	2,948	148	295
Vegetated Wetland	3,059	0	2,732	5,464	1,366	2,732
Forest	9,059	2,717,800	12,943	20,225	404	1,618
Quarries	192	4,250,800	858	1,715	343	857
TOTAL LAND (lbs)		105,446,800	94,508	110,375	7,520	15,520
AVERAGE DAILY LOAD (lbs)		288,895	259	302	21	43

B-5

Pollutant Loading from Malfunctioning Septic Tanks

Because malfunctioning septic systems are a major source of pollution in the North Central Ocean Basin (WRA, 1976), a first-order calculation of this load was attempted for this EIS. The calculation is limited because numerous assumptions are required to provide several parameters:

EPA based its calculation upon the following estimates of summer populations using septic tanks:

West Ocean City	6,800	GMB (1977)
Berlin	1,600	Assumed
Route 50 Corridor	1,000	Assumed
Jenkins-Turville Neck	400	Assumed
Sinepuxent Neck	1,000	Assumed
Isle of Wight	100	Assumed
	<u>10,900</u>	

Each septic tank serves an average of 3.5 persons

$$10,900 \text{ persons} / 3.5 \text{ persons/tank} = 3,114 \text{ septic tanks}$$

At any time approximately 4.3 percent of the tanks are subject to failure (WRA, 1976)

$$3,114 \text{ septic tanks} \times 4.3 \text{ percent} = 134 \text{ failing septic tanks}$$

134 septic tanks serve 469 individuals

$$134 \text{ septic tanks} \times 3.5 \text{ persons/tank} = 469 \text{ persons}$$

Per capita wastewater flows were assumed to be 75 gpcd

$$469 \text{ persons} \times 75 \text{ gpcd} = 35,175 \text{ gallons/day}$$

Effluent from the failing septic tanks was assumed to have the strength of "weak" sewage (Metcalf and Eddy, 1972):

Suspended solids	100 mg/l
BOD ₅	100 mg/l
Total nitrogen	20 mg/l
Total phosphorus	6 mg/l

These flows and concentrations are equivalent to the following loading rates:

Suspended solids	29 lbs/day
BOD ₅	29 lbs/day
Total nitrogen	5.9 lbs/day
Total phosphorus	1.7 lbs/day

Air Quality - Incineration

Local impacts of the incinerator emissions can be modeled using equations and atmospheric dispersion coefficients developed by Turner (1970). The stack is assumed to be a single point source and the emission plume is assumed to diffuse horizontally and vertically as it is transported downwind, according to a Gaussian distribution. The model accounts for both wind speed and atmospheric stability. However, these factors need not be known to estimate worst case concentrations.

The physical characteristics of the incinerator are:

Stack Height:	11.6 m
Stack Diameter:	0.2 m
Gas Exit Velocity:	assume 6 m/sec
Gas Temperature:	50°C

Plume rise is estimated using the Davidson-Bryant formula (Briggs, 1969):

$$\Delta h = \frac{Vs}{u} 1.4 \left(1 + \frac{T_g - T}{T}\right) d$$

where: Δh = the rise of the plume above the stack
 d = the inside stack diameter
 Vs = gas exit velocity
 u = wind speed
 T_g = gas temperature (°K)
 T = ambient temperature (°K)

For the "worst-case" condition, wind speed was assumed to be 1 m/sec and ambient temperature 70°F (294°K). Plume rise was calculated to be 2.7 m.

The only emission data available is 0.1 gr/scf (228 mg/m³) at 350 lbs/hr sludge feed. Assuming that the emission rate is proportional to the sludge feed rate, at 600 lbs/hr emissions would be 391 mg/m³. Maximum short-term ground level concentrations calculated after Turner (1970) are shown in Table B-6.

Table B-6. Maximum Short-Term Particulate Concentration from the Ocean City Incinerator.

Stability Class	Distance to Point of Maximum Impact (m)	Concentration (µg/m ³)
A	690	35
B	400	37
C	260	41
D	130	44
E	100	41
F	80	22

Air Quality - Automobile Traffic

Carbon Monoxide (CO) concentrations in the Ocean City area were modeled to determine the impact of increased vehicular traffic in the study area.

CO concentrations in the vicinity of a highway depend upon traffic volume, emission rate of the vehicles, wind speed and direction, and atmospheric stability. "Worst case" conditions were assumed for all of these parameters in the analysis.

Two locations were selected as representative for modeling. The first site was Maryland Route 50 west of Ocean City and the second was Philadelphia Avenue, north of North Division Street. Average Daily Traffic (ADT) counts were available at both locations for 1973 (Ewell, Bomhardt and Associates, 1975). ADT was 10,650 vehicles on Route 50 and 16,300 vehicles on Philadelphia Avenue. The peak month of the year was July, when traffic was 200 percent of the yearly ADT (Ewell, Bomhardt and Associates, 1974). Peak day traffic also occurs Sundays, when it is 160 percent greater than the average day. The peak hour traffic volume is approximately eight percent of the daily traffic. Peak hourly traffic volumes at the two locations in 1973 were 2,726 vehicles on Route 50 and 4,173 vehicles on Philadelphia Avenue.

The July, 1973, population in Ocean City based on "Demo-flush" statistics was 108,800 persons. GMB has predicted a peak summer population in Ocean City in 2000 of 205,000 persons. Assuming that the traffic volumes are proportional to the population, peak hourly traffic in 2000 will be 5,090 vehicles on Route 50 and 7,791 vehicles on Philadelphia Avenue. These volumes may not be realized because Philadelphia Avenue is already operating at level of service F (severely congested) and Route 50 is at level of service C during peak hours. However, for the purposes of this analysis it was assumed that sufficient improvements will be made so that those traffic volumes could be accommodated.

Vehicular emission factors were calculated based on AP-42, supplement 5 (EPA, 1976) and worst case vehicle running conditions. The vehicle mix was assumed to be an average of Baltimore and Washington. Only light-duty, gasoline powered automobiles were considered. Traffic speed was estimated to be 15 mph on Philadelphia Avenue and 40 mph on Route 50. Emission factors for the year 2000 are as follows:

Philadelphia Avenue: 3.696 gm/veh/mi

Route 50: 1.303 gm/veh/mi

Wind speed was assumed to be 1 m/sec at a 22.5° angle to the roadway. Atmospheric stability was assumed to be Pasquill stability class F.

CO concentrations at the edge of the roadway were estimated using the California State Division of Highways (1972) formula:

$$C = \frac{1.06 Q}{K U \sin \phi}$$

where: C = concentration of CO (gm/m³)

Q = emission rate (gm/sec-m)

u = wind speed (m/sec)

K = empirical coefficient - 4.24

φ = angle of wind with respect to roadway

The input values and the resulting concentrations are shown below in Table B-7.

Table B-7. Model Parameters and Resulting CO Concentration from Automobiles for Specific Sites in the North Central Ocean Basin

<u>Location</u>	<u>Vehicles per Hour</u>	<u>Q (gm/sec-m)</u>	<u>CO Concentrations (ug/m³)</u>
Philadelphia Avenue	7,191	4.98 x 10 ⁻³	3.3
Route 50	5,090	1.15 x 10 ⁻³	0.7

National and State standards for CO are:

8-hour maximum 10 ug/m³

1-hour maximum 40 ug/m³

Neither standard will be exceeded more than once per year. The worst one-hour concentration estimated to occur in Ocean City in the year 2000 was 3.3 mg/m³ which is eight percent of the applicable standard. For this concentration to be measured, the "worst case" meteorological conditions would have to coincide with the peak hourly traffic on a Sunday in July. This is not likely. Therefore, the increased population in the study area will not have a significant secondary impact upon air quality.

Sampling Methodologies and Results for the Proposed West
Ocean City STP Site

Trees (individuals greater than 4 inches dbh) were sampled in the eastern and western sections of the site using the "random pairs" method (Cottam and Curtis, 1955, 1956) to determine the plant community structure of each. Sixty-two "pairs" were sampled in the eastern sector and fifty in the western. A running mean was plotted for each to insure adequate sampling size (Kershaw, 1973). Relative frequency, relative density, and relative dominance were calculated from presence and dbh data for each species having frequencies greater than 5 percent. These values were then summed to determine importance values per species. All of these values were used in discerning the structure of both stands. Results for the eastern and western sectors are presented in Tables B-8 and B-9 , respectively.

Table B-8. Relative Frequency(%), Density(%), and Dominance(%), and the Importance Value(%) of Species Sampled in the Swampy Western Portion of the Site. The Species are Arranged in Order of Decreasing Importance Values. [Source: Field Studies].

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Values</u>
Sweet gum	26.0	50.9	38.8	115.7
Red maple	38.0	13.4	23.8	75.2
White oak	28.0	19.7	25.7	73.4
Unidentified oaks*	8.0	16.0	11.7	35.7

* These oaks are impossible to identify with certainty in winter condition. Probable species based upon leaf litter examination and bud characteristics include pin oalk, willow oak, water oak, and chestnut oak.

Table B-9. Relative Frequency(%), Density(%), and Dominance(%), and the Importance Value(%) of Species Sampled in the Softwood-Hardwood Community Located in the Eastern Portion of the Site. The Species are Arranged in Order of Decreasing Importance Values. [Source: Field Studies].

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Values</u>
Scrub pine	16.7	5.9	31.6	54.2
Red maple	18.3	25.5	8.1	51.9
Loblolly	10.0	14.1	26.0	50.1
White oak	16.7	12.5	10.9	40.1
Black oak	16.7	7.4	15.2	39.3
Unidentified oaks*	5.0	20.8	1.8	27.6
Sweet gum	11.6	9.4	2.5	23.5
Mockernut hickory	5.0	9.4	3.9	13.3

* These oaks are impossible to identify with certainty in winter condition. Probable species based upon leaf litter examination and bud characteristics include red and spanish red.

APPENDIX C
CORRESPONDENCE

C-1



HERBERT M. SACHS
DIRECTOR

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
WATER RESOURCES ADMINISTRATION
TAWES STATE OFFICE BUILDING
ANNAPOLIS, MARYLAND 21401

May 12, 1977

Mr. Dilip V. Kalyani
Edward H. Richardson Assoc. Inc.
P.O. Box 935
Dover, DE 19901

Dear Mr. Kalyani:

The Water Resources Administration recently completed a water quality investigation of Trappe Creek in Worcester County. The investigation, was conducted to establish future effluent limitations for the City of Berlin's wastewater treatment plant in association with the Facilities Plan evaluation of wastewater treatment alternatives. A copy of the final report will follow shortly under separate cover.

Surveys made in the past indicated that severe eutrophic conditions exist in Trappe Creek at certain times of the year. The investigation therefore centered on identifying the sources and amounts of nutrient discharged to Trappe Creek and the degree to which these nutrients impact water quality.

To accomplish the above, a mathematical model was developed of the estuarine portion of Trappe Creek. The model was calibrated using limited analytical field data and run for the various treatment and discharge options.

Results of the model runs indicate that Trappe Creek is very sensitive to the discharge of both nitrogen and phosphorous. The results also showed that Trappe Creek has a very low assimilative capacity, as well as a long residence time. As a result, even if all point sources of discharge were eliminated, background conditions in Trappe Creek would most likely cause dissolved oxygen to be naturally lower than desirable at least sometime during the year. Of course these low dissolved oxygen occurrences would be far less frequent and severe than those presently observed.

The Administration therefore recommends, based upon this most recent water quality investigation, that the discharges from the Berlin Wastewater Treatment Plant be eliminated from Trappe Creek and that the option to connect with regional wastewater treatment facility at Ocean City be exercised.

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As a minimum, this agency will require phosphorous removal to .3 mg/l or nitrogen removal to 3 mg/l for continued discharge to Trapps Creek from the Berlin facility. Additional water quality investigations are planned for the future, and more stringent requirements might be imposed as a result of these studies.

The Administration is presently considering a modification of the existing Discharge permit limits for BOD and TSS. Because of the timely completion of our investigation we will seek to include the requirements for phosphorous or nitrogen removal in with the modification of the BOD and TSS limitations. I will be in contact with the town concerning the inclusion of these new limits in the Berlin Discharge permit.

I hope this information will be of help to you in completing the evaluation of treatment alternatives for the Berlin treatment facility. If you have any questions please do not hesitate to contact me at 269-3821.

Sincerely,

Peter S. Tinsley

Peter S. Tinsley, Chief
Municipal & Agricultural Wastes Section

PST:dlk

cc: George Forbes
Lee Murphy
Jim Hagen



United States Department of the Interior

NATIONAL PARK SERVICE

MID-ATLANTIC REGION
143 SOUTH THIRD STREET
PHILADELPHIA, PA. 19106

IN REPLY REFER TO:

D5039
(MAR) PSF

MAR 9 1967

Mr. Norman Connell
District Engineer
Worcester County Sanitary
Commission
6405 Seabay Drive
Ocean City, Maryland 21842

Dear Mr. Connell:

In his letter of March 2, Acting Superintendent Estes of Assateague Island National Seashore noted that he would consult this office with regard to the "North-Central Ocean Basin Wastewater Facilities Plan," and that we would provide written comments.

This office appreciates the importance of the proposed project to Worcester County, and recognizes the benefit to the environment of adequate wastewater treatment. However, we are concerned about the proposed outfall crossing Assateague Island. Such a crossing will require a right-of-way permit from the National Park Service. The regulations governing issuance of such a permit require public involvement and a determination by the Secretary of the Interior that issuance is in the public interest and that there is no feasible and prudent alternative. We would expect intense public interest in any permit for a pipe line crossing the National Seashore, the process involved will be time-consuming, and we cannot now predict whether or not the Secretary would finally approve issuance of the permit.

We recently received a memorandum from the Acting Director of the National Park Service which contains the following guidelines:

"In authorizing a mechanism for the granting of rights-of-way through parks, the Congress provided for a discretionary exercise of authority. Thus, rights-of-way may be granted only after the Secretary of the Interior has determined that such an action is clearly in the public interest. In effect, Congress established a policy discouraging the granting of rights-of-way through parks.

"There are tests to be applied in consideration of rights-of-way applications. During examination, and before granting a right-of-way, there must be a finding that there exist no feasible and prudent alternatives to the proposed action. Upon such a finding, there must be provided ample opportunity for public review and comment, and as appropriate, a mechanism for appeals to the Secretary."

In addition, Public Law 94-578, approved on October 21, 1976 contains some specific language concerning Assateague:

"Sec. 301. The Act of September 21, 1965 (79 Stat. 824), as amended (16 U.S.C. 459f), providing for the establishment of the Assateague Island National Seashore in the States of Maryland and Virginia, is further amended by repealing sections 7 and 9 in their entirety, and by adding the following new section 12:

"Sec. 12. (a) Within two years of the date of enactment of this section, the Secretary shall develop and transmit to the Committees on Interior and Insular Affairs of the Senate and the House of Representatives a comprehensive plan for the protection, management, and use of the seashore, to include but not be limited to the following considerations:

"(1) measures for the full protection and management of the natural resources and natural ecosystems of the seashore;

"(2) present and proposed uses of the seashore and the lands and waters adjacent or related thereto, the uses of which would reasonably be expected to influence the administration, use, and environmental quality of the seashore;

"(3) plans for the development of facilities necessary and appropriate for visitor use and enjoyment of the seashore, with identification of resource and user carrying capacities, along with the anticipated costs for all proposed development;

"(4) plans for visitor transportation systems integrated and coordinated with lands and facilities adjacent to, but outside of, the seashore; and

"(5) plans for fostering the development of cooperative agreements and land and resource use patterns outside the seashore which would be compatible with the protection and management of the seashore.

"(b) Notwithstanding any other provision of law, no Federal loan, grant, license, or other form of assistance for any project which, in the opinion of the Secretary would significantly adversely affect the administration, use, and environmental quality of the seashore shall be made, issued, or approved by the head of any Federal agency without first consulting with the Secretary to determine whether or not such project is consistent with the plan developed pursuant to this section and allowing him at least thirty days to comment in writing on such proposed action."

Again, we fully support the objective of providing better waste treatment for Worcester County. We are eager to cooperate in any way we can within the framework of the laws and regulations within which we must operate to attain this objective. However, we do feel that you should be aware of the difficulties and uncertainty which an application for such a permit will face. In this regard, our comment on this proposal does not satisfy the requirement for eventual consultation with the Secretary.

Sincerely yours,

(Sgd) Nathan B. Golub

Benjamin J. Zerbey
Acting Regional Director
Mid-Atlantic Region

cc: Wayne Tyndall, Ecolsciences Inc., 133 Park Street NE,
Vienna, Virginia 22180, w/c of inc.

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Maryland Historical Trust

April 5, 1977

Mr. Edward F. Wandelt
Environmental Planner
EcolSciences, Inc.
Mid-Atlantic Region
133 Park Street, N.E.
Vienna, Virginia 21180

Dear Mr. Wandelt:

In response to your letter of March 29, 1977, concerning a draft environmental impact statement for a new sewage treatment plant, an expansion to an existing sewage treatment plant and sewage interceptors in eastern Worcester County, the following properties have been entered on to the National Register of Historic Places:

Caleb's Discovery
Buckingham Archaeological Site
Henry's Grove
Sandy Point Archaeological Site
Genesar
Mason Dixon Line Market

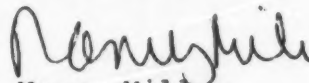
St. Martin's Episcopal Church and Henry's Grove have been approved for nomination to the National Register by the Maryland State review board. The Fenwick Island Lighthouse, Bishop House, Gillis Store, Evan House, Merry Sherwood, Charles Ewell House, Golden Quarter, Fassitt House, George Purnell House, Old Lime Kiln, Newport Farmhouse and Williams' Grove would probably be eligible for entry on to the National Register. The Worcester County inventory is not complete, especially for Berlin and Ocean City.

The archaeological sites represent those known and do not represent the product of a thorough survey. You might want to check your location of the Buckingham Site.

The Maryland Environmental Policy Act protects historic and natural resources. The historic area zoning Sections of Article 66B of the Annotated Code enables jurisdictions to zone properties historic. The enabling legislation of the Maryland Historical

Trust provides for preservation through ownership either in fee or in less than fee. The Archaeological Resources Section of Article 66C protects archaeological sites.

Sincerely,



Nancy Miller
Historian/Deputy State
Historic Preservation Officer

NAM/njm

cc: Mr. John L. Graham
Mr. L. Richard Phillips
Mr. Michael Bourne



Maryland Historical Trust

June 15, 1977

Mr. Wayne Tyndall
EcolSciences, Inc.
133 Park Street, N.E.
Vienna, Virginia 22180

Dear Mr. Tyndall:

In response to your letter of May 31, 1977, regarding historic sites in eastern Worcester County, Henry's Grove has been approved for nomination to the National Register but is not yet on the Register. Burley Manor was entered on to the National Register of Historic Places on June 7, 1974. I'm sorry this was not made clear in my April 5, 1977 letter.

Sincerely,

Nancy Minton

Nancy Minton, Secretary

for

Nancy Miller
Historian/Deputy State
Historic Preservation Officer

NAM/njm

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TELEPHONE 235-0771
235-1792

MARYLAND GEOLOGICAL SURVEY

LATROBE HALL, THE JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND 21218

Division of Archeology
13 July 1977

Mr. Wayne Tyndall
Ecol Sciences, Inc.
Environmental Consulting Services
133 Park Street
Vienna, Va. 22180

Dear Mr. Tyndall:

Your letter of June 2, 1977, requests information on archeological resources within the North Central Ocean Basin Wastewater facilities plan area. Although there has been no systematic surface survey of the vicinity, several sites have been reported. These have been located on the attached map.

The Buckingham Site, located near Beaverdam Creek, 18 WO 11, is a Middle Woodland Village site. It was entered on the National Register of Historic Places in 1975. The Sandy Point Site, 18 WO 12, found along the Sinepuxent Bay, was also entered on the National Register of Historic Places in 1975. Shell middens, refuse pits, and burials have been excavated at this site. The St. Martins Site, 18 WO 10, at the mouth of St. Martins River, contains pottery sherds of the Townsend series and debitage. Two sites, Beach, 18 WO 22, and Indian Knoll Landing, 18 WO 6, have possibly been destroyed due to land development. Projectile points, flakes and tools have been found at these sites.

Areas of potentially significant archeological sites include the shore lines around St. Martins Neck and Sinepuxent Neck and inland river and stream banks. Fenwick and Assateague Island would not be potential site areas because they are recent formations.

When planning reaches the stage of considering specific alternate sites, we recommend that a field reconnaissance be undertaken by a qualified archeologist in order to determine the archeological sensitivity of each alternate.

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Once the area of construction has been determined, we recommend that a qualified archeologist undertake an intensive survey, if determined necessary by the previous reconnaissance, to determine if there are significant archeological remains that should be preserved or require mitigation.

Information pertaining to historical sites within the area can be obtained by writing to Mr. John Pearce, State Historic Preservation Officer, Maryland Historical Trust, 21 State Circle, Annapolis, Md. 21401.

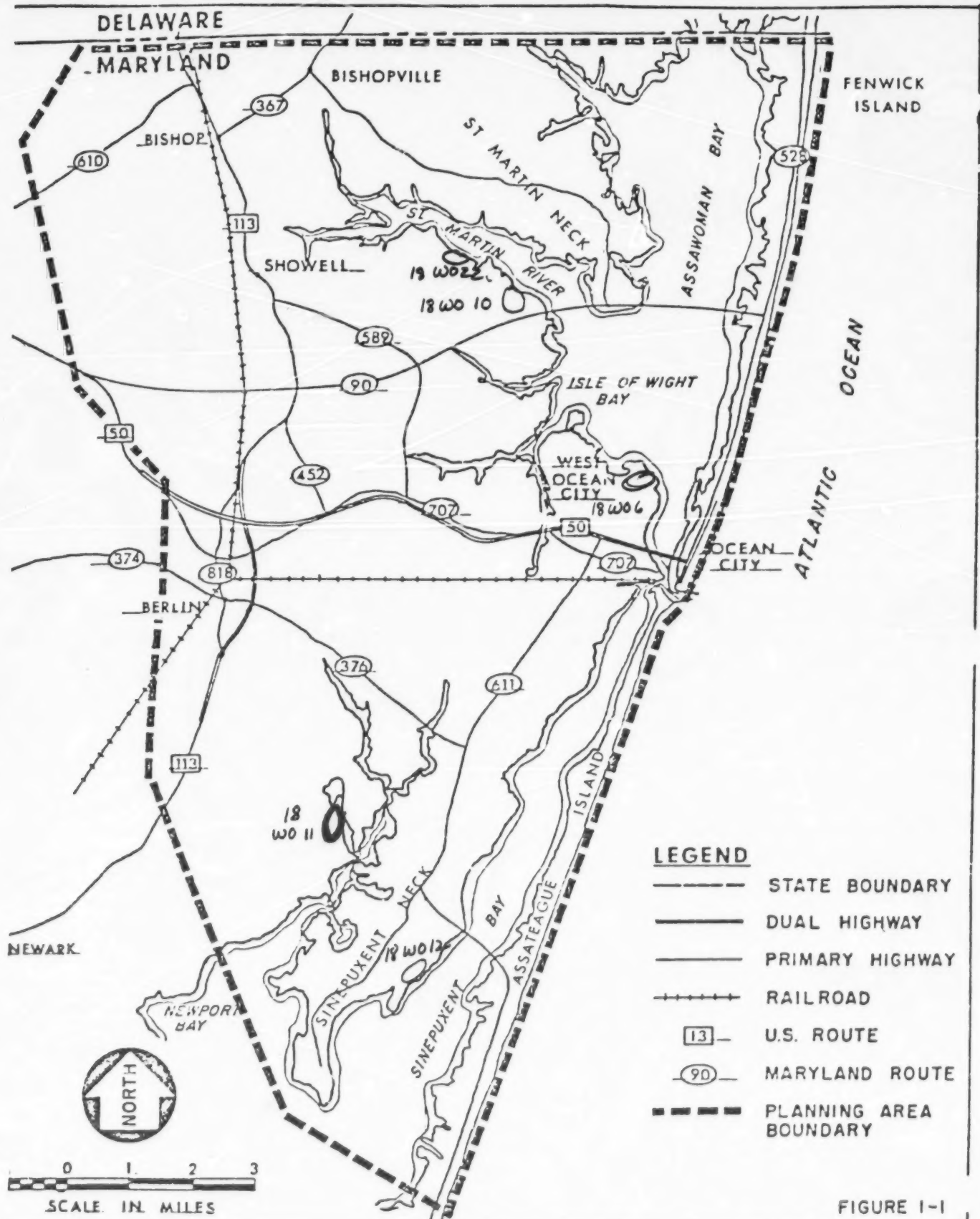
Sincerely,

Tyler Bastian
State Archeologist

TB:LEB:mlw

cc: John Pearce

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NORTH-CENTRAL OCEAN BASIN FACILITIES PLANNING AREA

1121 Harvey St.
Green Bay, WI 54302
June 3, 1977

Mr. Wayne Tyndall
Ecolsciences, Inc.
133 Park Street NE
Vienna, Virginia 22180

Dear Mr. Tyndall:

This is in reference to your letter of April 8, 1977, concerning the possible environmental impacts of the North Central Ocean Basin Wastewater Treatment facilities plan.

Construction would have little or no effect on the species of colony nesting birds using the area if conducted where your map indicates and done between, at the earliest November 1 and at the latest, February 28, as the birds are not present in the area at these times. Colony nesters are highly susceptible to disturbance by excessive noise and human activity. Although the area of proposed construction lies at least 4500 ft. from the nearest large colony and should be far enough away to permit construction to start earlier, there is less chance of harming the resource if construction is done during the time period previously stated. I would recommend that under NO circumstances should the pipeline be constructed between March 15 and September 1st. Another factor that should be considered in planing the construction dates would be local waterfowl seasons. In my opinion, it would be unwise to have the large amounts of human activity required to build the pipeline going on during these hunting seasons. The activity would/could alter daily waterfowl behavior patterns and make them more susceptible to hunting pressures and it could cause some danger to the construction workers.

Because colony nesters have an unusual nesting behavior, their habitat and behavioral requirements should be considered when planning projects of this type and you are obviously trying to anticipate as many of the environmental affects as possible. For your information, the closest colony to the project is a colony of Laughing Gulls located at "A" on the enclosed map. This colony has been active from indications by others for many years. In 1976, the colony was approximately 150-200 pr. "B" on the map is where there has, at times, been a colony of Least Terns, and common Terns.

They were not present during the summer of 1976. Least Terns also usually nest along the high beach areas just in front of the primary dune all along the north end. Least Terns are "finicky" nesters and often break up and move colonies with little provocation. Often they cannot be counted on to use the same colony two years in a row.

In summary, construction as proposed should have little or no impact on Sinexpuxent Bay's populations of colony nesters if done between November 1 and February 28.

Sincerely yours

David Brinker

David F. Brinker



UNIVERSITY OF MARYLAND
Division of Agricultural and Life Sciences
College Park 20742

Department of Botany
(301) 454-3812

May 16, 1977

Mr. Wayne Tyndall
Ecol Sciences, Inc.
133 Park Street, N.E.
Vienna, Virginia 22180

Dear Mr. Tyndall:

The plant species of which you inquired, Lechea maritima, is indeed represented in Ms. Elizabeth Higgins' collections from Assateague Island. However, the single specimen located is in poor condition, and neither Ms. Higgins nor I can verify whether it is var. maritima or var. virginica.

I'm sorry we can't be of more help. May I suggest that you contact Mr. Peter Mazzeo, a curator at the National Arboretum. He is expert at the Virginia flora and may have better information for you.

Yours very truly,

C. Rose Broome
Assistant Professor of Botany

CRB:jw

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May 11, 1977

Mr. Wayne Tyndall
Ecological Sciences, Inc.
133 Park Street, N.E.
Vienna, Virginia 22180

Dear Mr. Tyndall:

In reference to your letter of April 6, 1977, I would like to submit the following recommendations.

According to Dr. Prescott Ward, the area of Assateague Island where the impact would occur receives high usage by migrating Peregrine Falcons. Consequently, there should be no activity or habitat alteration in that area between September 1 and November 30, and between March 15 and May 15, of each calendar year.

There are no plant species presently listed as endangered by either Federal or State of Maryland regulations. Several species are now under consideration for listing by the U.S. Department of the Interior. When they are officially listed, they will be given protection under Maryland regulations as stated in the Non-Game and Endangered Species Conservation Act of 1975. For your information, Lechea maritima var. virginica is one of the species being considered for listing.

Finally, be advised that there is an active bald eagle nesting area within the North Central Ocean Basin planning area. I have marked the general location in red on the enclosed area map.

Sincerely,

Gary J. Taylor
Endangered Species Project Leader

GJT:sgl

cc: Steve Miller

Enclosure

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THE PENNSYLVANIA STATE UNIVERSITY

MONT ALTO, PENNSYLVANIA 17237

Mont Alto Campus

April 25, 1977

Mr. Wayne Tyndall
ECOLSCIENTISTS Inc.
133 Park Street, N.E.
Vienna, Virginia

Dear Mr. Tyndall:

In response to your letter of April 7, 1977 concerning the possible impact of construction on the ponies of Assateague Island, I would like to submit the following information.

1. I would suggest the fall or perhaps winter as the desired season for construction of the proposed pipeline. Spring and Summer are periods when foaling occurs and young animals are being raised. To ensure that the birth and nursing processes are not disturbed, I suggest no activity on your part at those times

2. The location of the proposed pipeline and construction presents some problems. First, from the way I interpret the map, construction will pass close to or affect one of the few freshwater drinking sources on the north end of the island. Construction south of that slag heap ("mountain of sand") would remove activity from the water hole and not destroy this important part of the ponies ecosystem.

Even if the waterhole is avoided, construction might still interfere with the movement of the ponies to and from this area. During the warmer periods of the year (April-November), the animals make 1 to 2 trips daily to these drinking sites, including the one in question. Often these walks take 15 minutes with the herd moving from the extreme northern tip of the island down to the waterhole in question. Construction might prevent the animals from moving freely to the drinking site or might even block the movement of the animals up and down the island. Likewise, the construction activity close to the waterhole may affect their behavior.

While the animals are reasonably tolerant of the presence of man, they can be spooked by groups of people. Likewise, I am not sure how they would react to the sounds and activities of construction equipment and teams of workers. I suspect that if the waterholes are avoided, if the work is done at seasons of the year when no critical reproductive activities are taking place, and if the movements of the herd up and down the island are not affected, then construction can take place without a significant effect on the ponies.

I would expect, of course, that construction ditches would not be left uncovered or unguarded at times when workers were not present. The animals, as I've already suggested, move up and down the island in essentially a daily cycle, and would be susceptible to falling into an uncovered ditch. Such movement often occurs at night when the ponies have reduced visibility. In addition to the above precautions, I might suggest a gradual excavating process so that areas on both sides of the digging are left available for pony movement.

In addition to the effect of the construction on the ponies, I am also concerned about such action on the island itself. I would hope that such construction would not have any permanent effect on the saltmarsh along the bay side of the island. The area of saltmarsh is already reduced in size due to natural processes, those these have been accelerated by the actions of man, yet this area is vital to the continued existence of the ponies since they graze extensively on these areas. Likewise, the area is already susceptible to over-wash. I would hope that construction would not increase this susceptibility, since increased overwash could lead to formation of an inlet and division of the island and hence isolation of the pony herd to the north end. Finally, I would hope that construction would have no permanent effect on the dune system and the American Beach Grass that vegetates the dunes.

Please contact me if you need additional information. I ask that your firm emphasize the important of handling the barrier island ecosystem, with its unique group of ponies, very gently during construction so that no permanent damage is done to this area.

Sincerely,

Ronald A. Kelper

Ir. Ronald E. Kelper



NEWARK COLLEGE OF ARTS AND SCIENCES • INSTITUTE OF ANIMAL BEHAVIOR
101 WARREN STREET • NEWARK • NEW JERSEY 07102 • 201/648-5862

April 22, 1977

Mr. W. Tyndall

Ecolsciences Inc.
133 Park Street, N.E.
Vienna, VA 22180

Dear Mr. Tyndall:

I have visited Assateague Island during the 1975 and 1976 breeding seasons to look for colonies of Common terns. I found no common terns nesting on the North end of the island in either season and have recently found that the Common terns have moved their colony sites to marsh islands west of Assateague Island (ie across Sinepuxent Bay). Thus any construction that did not involve the adjacent marsh islands would probably not affect the Common terns.

I did observe several pairs of nesting least terns both in 1975 and 1976 located on the beach, east of the first set of dunes. Unlike the Common tern, the least tern has not been to change habitats as a result of human destruction and use of beaches, and the populations of this species on the east coast have been seriously depleted. The least terns occupy the beaches from early May through the summer so that construction in the area of the beach would be most detrimental during this breeding period. There are other marsh birds nesting west of the dunes and their breeding period roughly coincides with that of the least tern. None of these other species are as endangered as the least tern but postponing construction until after the end of the summer would be beneficial to these species as well.

Please let me know if I can supply you with additional information.

Sincerely,

Anne Storey

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UNIVERSITY OF DELAWARE
NEWARK DELAWARE
19711

COLLEGE OF ARTS & SCIENCE
DEPARTMENT OF GEOLOGY
101 PENNY HALL
PHONE 302-738-2569

April 11, 1977

Dr. Piet deWitt
Project Manager
Ecolsciences, Inc.
Corporate Office
127 Park Street, N.E.
Vienna, Virginia 22180

Dear Dr. deWitt:

Thank you for your letter and map regarding alternate outfall locations for the Maryland Peninsula region. I really do not have too much comment in which I believe I can be of help to you. Ocean outfalls have several problems. If they are close to the beach, then they might tend to contaminate the beach and make it a less favorable type of area for recreation. They might also affect the biology of the nearshore submarine zone. On the other hand, outfalls that are a significant distance from the beach usually have little effect on them. The important thing that is involved is the nature of the outfall structure as it crosses the shoreline zone. If the outfall is buried deep enough (i.e. 30 ft. or more) as it goes into the nearshore zone then it will probably have little groin or jetty effect. However, if the structure is buried across the barrier and then emerges into the surf zone at a relatively shallow level it will most certainly create a groin effect and start erosion on one side and deposition on the other. I cannot tell from your plans and alternate what the actual plan is in terms of crossing the barrier zone. A further problem with ocean outfalls is that of coastal retreat or erosion which may tend to clog the outfall zone with sediment if too close to the shoreline and may tend to be subject to storm destruction if too shallowly buried. I would urge great caution in any plan that is made that burial be at a shallow depth. It is important to note that storm waves that can and will occur along this coast are active at all the relatively moderate depths in the immediately offshore zone. One of these storms could be strong enough, to tear up the end of the outfall system, if not properly engineered. However, your engineers should be aware of this and able to handle this.

In regard to the outfall options, it would seem to me that using an existing outfall such as the Ocean City outfall, if it can handle the total volume, would be the best method. Multiple outfalls are, in my opinion, not particularly desirable as they spread the potential problem over a wider area. Insofar as the outfall crossing a park,

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I do not think that is relevant. What is more relevant is whether or not the outfall is properly engineered and constructed to withstand the immense wave energies of the Atlantic coastal storms of this region. Of secondary concern, as stated above, is the problem of outfall onto a beach that is either a wildlife refuge, or an actively used park area. This problem of course occurs in Ocean City. My normal feeling regarding this matter is that outfall exits should be many miles offshore. However, I have never found an engineer to agree with me. The reason is of course, the tremendously increased cost of great lengths of outfall piping systems into the deeper part of the ocean. However, that is the really safe area in which to have an outfall as opposed to the immediate nearshore submarine zone.

Even though the outfall is treated, there can be no question that nearshore line outfalls will effect the desirability of the area from the point of view of people occupying the zone and from the point of view of possible effects on the biota of the area. One last observation is that the Ocean City outfall is preferable from the point of view that a very heavy investment has been made in the city itself. Thus there would be a greater tendency to protect the coastal zone in Ocean City. Assateague Island is a rapidly transgressing island moving landward. You are going to have continual problems in the geologic sense of a transgressive barrier beach that you cannot stop. Thus, from this point of view, the two alternates selected to cross Assateague Island are poor alternates. Possibly this is not a rationale that you would like to follow but it does occur to me that Ocean City cannot prevent having an outfall system and will have to defend it in spite of every storm event or erosional event along the coast. On the other hand, Assateague Island is being kept in a more or less natural state. Thus natural processes will operate in this area and there will be, accordingly, little or no tendency for sympathy or financial support from the Federal Government, in charge of the Assateague Island National Seashore. It would be in their interest to ignore the problem and let someone else worry about it. This could lead to considerable dangers to the overall system.

I am sorry that I cannot be more specific. However, ocean outfalls on a transgressive barrier system are a difficult thing. The Ocean City outfall merits serious consideration from the point of view that Ocean City is an existing major city and must protect its outfall. The alternates selected for outfall sites do not have a back-up position or reason for existing. Thus I, in my opinion, would put them as a second or third choice. On the other hand, there is nothing inherently wrong with them insofar as someone is willing to continually spend money on them throughout the next fifty years or life of the outfall system selected.

I trust the above is of some use to you.

Yours very truly,



John C. Kraft
Chairperson and Professor

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